THURSDAY, MARCH 11, 1915.

A TEXT-BOOK OF FORESTRY.

Elements of Forestry. By Prof. F. F. Moon and Prof. N. C. Brown. Pp. xvii+391. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 8*s.* 6*d.* net.

THE progress of forestry in the United States is remarkable. It is barely twenty years since the first forest reserve was set aside by the Government at Washington, which to-day controls with a trained staff of foresters about 186,000,000 acres of national forests. Forestry is now a matter of great public interest, and is taught in universities, colleges, and schools, there being no fewer than twenty-three institutions giving degrees in the subject. In addition to numerous bulletins and reports issued by the U.S. Bureau of Forestry, there now appear two professional journals, the *Forest Quarterly* and the Proceedings of the Society of American Foresters. Various text-books on special branches of forestry have been published, but no general handbook suitable to students in America has hitherto appeared.

The "Elements of Forestry," by Moon and Brown, is an attempt to supply this need, and it is very satisfactory as an elementary text-book. It will serve as a good introductory work for professional students of forestry, and covers about as much of the subject as is necessary for students in agriculture. The book is clearly printed and well-illustrated. All the usual divisions of the science and art of forestry are taken up in a series of simple and attractive chapters, at the end of each of which is a short and useful bibliography. Of chapters i. to xiv., which are of universal application, those devoted to the utilisation, technology, and preservation of wood are of special interest; and much praise must be given to the chapter on forest finance, in which the gist of this important matter is expounded in sixteen pages. The attention of landowners and practical foresters may be directed to the example on p. 265, which illustrates the most common problem in forestry finance in England, namely, the estimate of the cost of raising a crop of trees to any given number of years of age, and incidentally determining whether a plantation is a profitable investment or not.

Chapters xv.–xxii., entitled "Regional Studies," deal with the conditions of the forests of the United States, which are divided into seven regions. The description, silviculture, protection, and utilisation of the forests of each region are briefly but adequately dealt with. At the end of the book, in addition to a glossary, there is a collection of useful tables and statistics. The average rate of growth of the important species of trees in the various regions is given in Tables VII.–XI. From this it appears that the most vigorous conifers in each region are as follows, the figures being for average trees 100 years old and grown under forest conditions.

Region	Species	Height in feet	Diameter in inches at 4½ feet up
Pacific Coast.....	Douglas Fir	138	20·5
	Western Hemlock	110	15·2
Rocky Mountains	Douglas Fir	86	21·1
	Pinus Murrayana	73	11·2
Northern	*Pinus resinosa*	95	17·6
	Pinus Strobus	92	20·0
Southern.....	*Pinus Taeda*	111	24·5

THE LANGUAGES OF SOUTHERN NIGERIA.

Specimens of Languages from Southern Nigeria. By N. W. Thomas. Pp. 143. (London: Harrison and Sons, 1914.) Price 4*s.* net.

MR. NORTHCOTE THOMAS has given us an exceedingly interesting piece of work in African philology by publishing for a reasonable price what might be called a sketch of the languages of Southern Nigeria between the frontier of the Bantu Cameroons on the east, and the Yoruba country on the west. The same ground was covered in 1888 by the writer of this review, but his work, which would be of interest in comparison with, and supplementary to, that of Mr. Northcote Thomas, was only privately printed by the Foreign Office. Perhaps some day it may be disinterred from a confidential blue-book and produced with other linguistic studies.

Mr. Thomas's specimens (prominent nouns, numerals, pronouns, and such syntax as can be illustrated by a variety of sentences) include nearly the entire range of the Ibô dialects, the languages of the Calabar and Cross River district; the Ijõ of the actual Niger mouths, Yoruba of the Lagos vicinity, Sôbô and Kukurúku of the Bini-Edo group, Ibibio of the region between the Calabar estuary and Opôbô, and a number of very interesting semi-Bantu languages on the verge of the Cameroons frontier. Mr. Thomas does not attempt much in the way of classification, but would seem to indicate that he finds a connection more or less close between the semi-Bantu Yala, which lies far to the north of the upper Cross River, and the Edo or Bini group in the western part of Southern Nigeria. No evidence of very close affinity, or of affinity at all, is to

be deduced from the actual vocabularies given. Personally, I should have been inclined to regard Yala (which is one amongst Koelle's many interesting vocabularies of 1854, hitherto difficult to locate geographically) as having nothing to do with Edo, but much with the more "semi-Bantu" speech contiguous to it on the east. Not the least interesting part of this useful manual is the identification *and* location of eighteen of Koelle's vocabularies, work which greatly enhances their value to the philologist. In addition, Mr. Thomas introduces us for the first time to several speech forms—languages and dialects—hitherto unknown.

Mr. Thomas's work throws a good deal more light on the semi-Bantu languages in addition to the not-sufficiently-known work of Mr. P. Amaury Talbot. The analysis of the material his vocabularies furnish induces me to account for the semi-Bantu group and cognate languages in two ways:—Some of them, especially in the east and south of their range, may be simply much-worn-down and corrupted real Bantu; relics of the comparatively ancient east-to-west migration, which finally carried a Bantu speech to the Island of Fernando Pô. But the balance of probability, especially in regard to the more northern groups of semi-Bantu, lies in the direction of their being descended from sister languages of the original Bantu mother tongue. They would thus have migrated from north-east to south-west. All such indications seem to lead to the theory that the original home of the Bantu was somewhere in the very heart of Africa, between the basins of the Benue, the Shari, the Mubangi and the Bahr-al-Ghazal. But Mr. Thomas's work further directs our attention to the existence of Bantu roots in Ibô and Gori; and this ancient Bantu influence can, I believe, be traced much farther to the west than the lower Niger. H. H. JOHNSTON.

HOUSEHOLD INSECTS.

(1) *Insects Injurious to the Household and Annoying to Man.* By Prof. G. W. Herrick. Pp. xvii+470. (New York: The Macmillan Co.; London: Macmillan and Co., 1914.) Price 7*s.* 6*d.* net.

(2) *The House-Fly,* Musca domestica, *Linn. Its Structure, Habits, Development, Relation to Disease and Control.* By Dr. C. G. Hewitt. Pp. xv+382. (Cambridge University Press, 1914.) Price 15*s.* net.

"HOUSEHOLD insects" have, for many years past, attracted the attention of entomologists in North America, and since the publication of the well-known Bulletins of the U.S. Department of Agriculture, by Dr. L. O. Howard and Mr. F. H. Chittenden, on pests of this nature, in 1896, much work of importance has been done, particularly with regard to house-flies and mosquitoes. Students of the subject should, therefore, be grateful to Prof. Herrick for providing a popular and trustworthy account (1) of our arthropodous "messmates" and parasites. In addition to insects in the zoological sense of the term, spiders, mites, ticks, solpugids, scorpions, and centipedes are passed in review, and the British reader cannot but feel that some compensation for not being an American is afforded by the comparatively scanty house-fauna of his native land.

The especial strength of Prof. Herrick's book lies in the directions given for dealing practically with the various pests; systematic and bionomic considerations are, throughout the volume, subordinated to the economic point of view. No fewer than one hundred pages are devoted to house-flies and mosquitoes; the disease-transmitting power of these insects is emphasised, albeit with the minimum of information as to the nature of the micro-organisms that they carry. Doubtless the author has been well advised to lay stress on the habits of the creatures that he describes in their relation to remedial and preventive measures, but if a little more space could have been devoted to the zoological aspects of the subject, the reader would take a more intelligent interest in the practical problems brought to his notice. Each chapter is followed by an "economic" bibliography, and the book is illustrated by more than 150 figures of somewhat unequal merit.

(2) Dr. Gordon Hewitt has, by his researches since 1907, made the House-fly (*Musca domestica*), to an especial degree, his own subject, and his transference from Manchester to Ottawa has not cut him off from an abundant supply of material of this cosmopolitan insect. In the handy volume now before us, all the anatomical and histological descriptions and figures from Dr. Hewitt's previously published works are collected in a convenient form, and a full survey of the latest literature on the house-fly and allied Diptera, together with an account of Dr. Hewitt's own recent investigations, will be found to furnish a store of information for the student. Interest in house-flies during recent years has centred around the possibility of these insects serving as carriers of disease-germs to human food-products, and the critical survey of the newest work on this subject—especially with regard to the prevalence of infantile diarrhœa during the fly season—forms a most valuable section of Dr. Hewitt's

book. Experiments carried on at Ottawa on the distances travelled by marked flies showed various ranges of flight up to 700 yards; observations quoted as made by Dr. Copeman in rural districts in Norfolk give a flight-range of 1700 yards. The book concludes with a discussion of the best methods for destroying fly-maggots and for checking the facilities for the breeding of the insects. Bavaria enjoys the reputation of a noteworthy paucity of flies, "perhaps due to the extreme cleanliness of Bavarian cities." Dr. Hewitt's book can be most heartily commended to all enthusiasts on behalf of public health, as well as to students of the anatomy and life-history of insects. G. H. C.

GEOGRAPHICAL TEXT-BOOKS.

(1) *A Geography of Australasia.* By Griffith Taylor. Pp. 176. (Oxford: Clarendon Press, 1914.) Price 1*s.* 6*d.*

(2) *The Pupils' Class-Book of Geography.* By E. J. S. Lay. England and Wales, pp. 80. Price 4*d.* The British Isles, pp. 118. Price 6*d.* The British Dominions, pp. 128. Price 6*d.* (London: Macmillan and Co., Ltd., 1914.)

(3) *Macmillan's Geographical Exercise Books.* With Questions by B. C. Wallis. i., The British Isles, pp. 48. Price 6*d.* ii., Europe, pp. 48. Price 6*d.* iii., The British Empire, pp. 48. Price 6*d.* (London: Macmillan and Co., Ltd.)

(4) *Bacon's Sixpenny Contour Atlas.* South-east England edition. Pp. 41. (London: G. W. Bacon and Co., Ltd.)

(5) *The Map and Its Story.* Pp. 44. (London: G. W. Bacon and Co., Ltd.) Price 1*s.* net.

(1) ONCE the pupil or student gets past the general outlines and principles of geography (which are so difficult for the author and teacher to lay down in terms that are otherwise than summary and dull), he ought to find out the real interests and fascination of the subject. A book like Mr. Taylor's will help him to do so. This writer has an unusual faculty for keeping steadily in view the interaction of those phenomena which geographers set out to study, and for picking out the right facts from the special departments of knowledge on which geographers have to draw. He also sets great store by the use of the map to illustrate special points, and in this direction shows considerable originality; the maps are generally clear, though sometimes injudiciously reduced, and occasionally rather severely generalised. The descriptive and explanatory writing could not well be clearer, and this being so, the author is safe in carrying his readers into such unaccustomed topics as that of the paragraphs in which he discusses the former history of river courses and the extent of land, a "journey into past geological times" which is justified, as he is able ingeniously to show the bearing of former physical conditions upon modern communications. This book would be an excellent introduction to Australasia as a special subject.

(2) Both the manner and the matter of Mr. Lay's three little volumes, according to their lights, are fairly satisfactory, and a large number of questions and exercises are provided, many of which will carry the pupil well beyond the scope of the work, and are properly suggestive. Others tend to throw back to the old narrow field of geographical teaching, demanding merely a list (*e.g.*, of "the highest mountains of the Pennine Chain"), while it is difficult to conceive in what possible geographical connection such a question is asked as, "Do you know the name of a Councillor? A Magistrate?" Pieces of poetry are set for learning, but the geographical value of poetry is too often doubtful, especially when its language is as difficult as that of W. J. Mickle's translation of Camoens. The text of these books illustrates at some points one of the geographer's besetting dangers, generalisation; such sentences as "Edinburgh, which is built on the famous Castle Rock"; "The Dominion of Canada is provided with a splendid system of waterways"; in the same country "the various minerals—with the exception of . . . gold and silver—are scarcely worked," are statements which, in the want of qualification, may be highly misleading.

The maps (black and white) in this series are commendable, though we should hesitate to subscribe to the claim that "no atlases or other maps" are "required." A point of some interest emerges on making a comparison of maps in this series in Mr. Taylor's book, and in "The Map and Its Story," presently to be noticed. The desirability is revealed of some attempt at standardising distribution maps. The maps illustrating the vegetation of Australia in these three books are, it is true, laid out on rather different systems, but their methods are sufficiently similar to show how widely divergent are the results obtained. A pupil comparing the three would be excusably "floored" in attempting to gather from them the extent and locality of forest and desert areas, and so forth, in Australia, and the differences are such that one or more of the maps must be very seriously in error.

(3) Mr. Wallis's "Geographical Exercise Books" consist of blank maps (sometimes with contour lines), and on the page facing each map a series of questions or directions as to filling it up and writing notes or exercises on the results obtained and the conditions revealed. Both maps and letterpress appear to be very judiciously chosen or compiled, and in the hands of a pupil of moderate capacity in draughtsmanship the finished product should possess a permanent value.

(4) Messrs. Bacon's "Sixpenny Contour Atlas" is very good, considering its price. It contains thirty-two coloured maps, showing the elevation of the land according to a recognised method, and dealing with the world and its various divisions, in addition to which there are a few maps of a special area, varying according to the pupil's requirements—*e.g.*, the edition under notice is that for south-east England, and contains special maps of that district, while editions for south Scotland, south Wales, and others are promised.

(5) The same firm's publication, "The Map and its Story," does not maintain the standard of the work previously noticed, so far as concerns its coloured maps illustrating climate, vegetation, etc. Some of the printing (*e.g.*, of the natural resources shown in red lettering) is bad, and some of the distribution colouring weak. But the distinctive feature of the work, the letterpress accompanying the maps, explains them very clearly, and ought to fulfil the purpose of guiding students as to what they should look for and find, not only on these, but on other maps.

OUR BOOKSHELF.

Huxley Memorial Lectures to the University of Birmingham. With an Introduction by Sir Oliver Lodge. Pp. 164. (Birmingham: Cornish Brothers, Ltd., 1914.) Price 5*s.* net.

Of the nine memorial lectures which have been delivered, the present volume contains only five. That by Prof. Joly on pleochroic halos does not even mention Huxley's name. Sir Oliver Lodge leads off with Huxley's own defence against the charge of materialism. "There is a third thing in the universe which . . . I cannot see to be matter or force, or any conceivable modification of either." This was consciousness. Sir Michael Foster found in Huxley the "conviction that what began as a search into things physical has become a search into things spiritual." Prof. Poulton points out that Huxley "never committed himself to a full belief in natural selection, and even contemplated the possibility of its ultimate disappearance." We come, in the remarkable paper by Prof. Percy Gardner, to the pith of the matter, "in regard to which words from Birmingham are greatly valued, the study of the subconscious side of man."

Prof. Bergson's lecture on life and consciousness traverses a field antipodal to that of Huxley. Consciousness is "the mind." It "and matter are antagonistic forces." It is at once a "creative force," a "vital impulse," and a "spiritual force." Life is "nothing but consciousness using matter for its purposes." It "cuts it up in order to bring about a greater precision." "The evolution of life . . . suggests to us the image of a current of consciousness which flows down into matter as into a tunnel." The final conclusion is "that with man consciousness has finally left the tunnel" to "pursue its path beyond this earthly life."

Dew-Ponds—History, Observation, and Experiment. By E. A. Martin. Pp. 208. (London: T. Werner Laurie, Ltd., n.d.) Price 6*s.* net.

A difficult problem has been attacked by Mr. E. A. Martin in this book. He defines a dew-pond as "one situated on the higher grounds, generally on the chalk downs of the south of England, which retains by some means or other a supply of water throughout all but the most prolonged droughts, whilst those ponds situated on the lower lands have consistently dried up." With the aid of continuous observation, and a grant from the Royal Society for experimental purposes, he has been able to throw much light on these curious ponds. He shows that "dew-pond" is a misnomer, for dew is quite insufficient to make up for loss by evaporation; and he inclines to the use of the term "mist-pond" as better explaining their origin. However, "dew-pond" is in common use, and when farmers speak of dew they include the condensation of mist and cloud also.

The author suggests that the small crystals of sodium chloride, found in sea air, have acted "as nuclei of condensation when the night-mists form on the downs, and as the mists blow up in the early morning from the sea they pass across the pond-depressions and are deposited in quantities there." Certainly it is to the morning mists drifting in from the sea that the replenishment of these ponds is mainly due. We would direct particular attention to some of the observations, in which are given actual measurements of the amount thus deposited. It is noticeable also what a large part is played by rushes or other vegetation in increasing the deposition. However, aspect, slope of ground, and other things all play their part, and great care is needed in the selection of a site.

We recommend this book to the notice of engineers and others who have to do with hilly regions where rain is deficient, but where heavy mists are common, as, for instance, the Pacific slopes of the Andes.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Resonance of Sodium Vapour in a Magnetic Field.

IT is well known from the observations of Wiedmann and Schmidt, Wood, Dunoyer, and others that dilute sodium vapour contained in a glass bulb emits resonance radiation when a soda flame is focussed upon it. During the last few days I have examined the effect on the resonance radiation of putting the resonating vapour in a magnetic field.

If the exciting flame contains very little soda, the resonance radiation is diminished by the field.

If, on the other hand, the flame is rich in soda, the field greatly increases the resonance radiation.

It is too early to put forward more than a tentative suggestion towards the explanation of these effects. Each sodium line emitted by the resonating vapour is broadened by the Zeeman effect. The flame poor in salt gives a narrow exciting line, and magnetic broadening throws a part of the resonating line off the exciting line, thus diminishing the light.

Adding more salt to the flame makes each exciting line broader, and (it is provisionally assumed) reverses the middle of it. Thus magnetic broadening of the resonance line tends to bring the brightest parts of the exciting line into action, and increases the light.

It may be remarked that with an intermediate condition of the flame a moderate field would produce the kind of effect last referred to, while a very strong field would separate the side components so far as to throw them beyond the limits of the exciting line. An effect of this kind has been observed, though unfortunately the condition of the exciting flame at the time was not noted. The current was switched on, and as the field increased (this takes a perceptible time) the resonance radiation increased and then diminished again. On turning the current off, the light again passed through a maximum. The greatest strength of field used in this experiment was about 14,000 units. Brightening can be distinctly observed with 1000 units, when a well-salted flame is used.

I have not been able to find that any previous observations have been made on the resonance of sodium vapour in a magnetic field. Observations were made on mercury vapour by Malinowski (*Phys. Zeits.*, September, 1913). The present experiments were suggested by some made in this laboratory by Mr. F. S. Philipps on mercury vapour (see NATURE, December 4, 1913). His observations were independent of Malinowski's.

R. J. STRUTT.

Imperial College, South Kensington, March 9.

The Spectra of Hydrogen and Helium.

DR. BOHR'S letter in NATURE of March 4, although giving an interesting discussion of some aspects of this problem, does not meet the particular point which my letter was designed to raise. This point was solely that since combination series must be expected from the "4686" series in any circumstances, and since the lines so calculated occupy the positions in which lines have been found by Evans, they cannot be used to discriminate between theories of the origin of spectra, for we cannot prove that the observed lines are not these combination lines. It is true that Bohr's theory involves the combination principle, but so also does that of Ritz, who originated the principle.

My letter (NATURE, February 11, p. 642) took up this purely negative attitude, and was not intended as a criticism of the theory. It did not even advocate a hydrogen origin for the lines. Fowler's view, that the "4686" series is a 4N series analogous to that in magnesium, was, in fact, stated to have more evidence in its favour. Whether the origin be really hydrogen or helium is not actually relevant to my argument. Even if the origin is really helium, it was pointed out by Fowler in his Bakerian lecture that his results do not formally imply Bohr's theory. Since that time, the writer has published a proof that the theory cannot explain 4N series in general, for such elements as magnesium. It can only deal with helium, and the formal analogy between helium and magnesium would weaken, rather than strengthen, the theory.

The greater part of Dr. Bohr's letter does not bear on my original point, for he is seeking to discriminate between a hydrogen and helium origin, and between his view and Rydberg's, not directly by Evans's experiments, but by other considerations. At the risk of going further from the point at issue, I feel that some remarks on these considerations are necessary.

The references to Rau's experiments on voltages necessary to produce series are interesting, and if they have been interpreted correctly—there is some doubt of this—they show that the chemical origins of the series are those stated by Dr. Bohr, and by Stark and others. They show also that the electrons in Bohr's model atoms have the proper angular momenta. There are other reasons for believing that the relation of the atom to Planck's h is contained in the angular momenta, and such atoms were treated by the writer some years ago, but with a different kind of emission. Nevertheless, Rau's experiments have nothing to do with the mechanism of spectral production, and cannot support any theory of the mechanism of radiation. For the radiation problem is quite superposed on any specification of the steady configurations of non-radiating atoms.

The remarks concerning Rydberg's view proceed throughout on the supposition that the usual constant μ—Rydberg's phase—is *zero* in these series. No such case is known elsewhere in the whole range of spectra. It is quite easy to fit the "4686" series into a formula exhibiting it as a principal series of hydrogen, if this constant μ is not arbitrarily chosen as zero. There are other arrangements of the disputed series as hydrogen series which are formally possible, but their description would occupy too much space here. A full account of the whole problem will be published shortly, so tnat I propose to discontinue the present discussion with this letter. Meanwhile a protest must be urged against Dr. Bohr's conviction that the spectrum of atomic hydrogen consists solely of the Balmer, Ritz, and Schumann series. For MM. Fabry and Buisson have shown that a very large number of lines in the "secondary" spectrum are due to atoms of hydrogen. A correct model of the hydrogen atom must account for more emission spectra than have yet been deduced by Bohr's theory. Finally, I must again state explicitly that my present purpose is not to call the theory into question. My only concern is to show that no decisive factor has yet entered, and that judgment between theories must at least be suspended for the present. The importance to physics in general of the whole question of spectral emission is so great that a hasty decision must not be made. And the fact remains that all the present experimental results are explicable in widely different ways. The test mentioned at the end of my previous letter still appears to be an obvious crucial one.

J. W. NICHOLSON.

University of London, King's College, March 5.

A Neglected Correction in Osmotics.

In the dynamic method of determining relative vapour pressures, air, initially dry, is passed first over the solution and then over the pure solvent. When it leaves the solution it has taken up a quantity of solvent vapour l_1; on leaving the solvent it contains a further quantity, l_0-l_1. While working on aqueous solutions at 0° C., Mr. Hartley and I had realised that the air when over the solution expands by an amount represented by the vapour pressure of the solution, similarly a further expansion takes places over the solvent, but as this further expansion is only that due to the difference of vapour pressures of the two liquids—say 1/10th of 4 mm. Hg—we had assumed that this small quantity was negligible in comparison with the total pressure.

Dr. C. V. Burton, of my laboratory, has pointed out to me that this assumption is not justified when osmotic pressures are to be calculated from the observed results. His discussion of the necessary correction is as follows. Let B be the barometric pressure and V the volume of air (measured when dry) passed through the system. The air in contact with the solution has a partial pressure of $B-\pi_\pi$, and the volume now occupied by it is increased to $VB/(B-\pi_\pi)$. Similarly, on leaving the solvent the volume has become $VB/(B-\pi_0)$. If ρ_1 and ρ_0 are the densities of the vapour in equilibrium with the solution and solvent respectively, the masses l_1 and l_0 are $\rho_1 VB/(B-\pi_\pi$ and $\rho_0 VB/(B-\pi_0)$.

Assuming that Boyle's law holds good for the vapour up to π_0, with sufficient accuracy for the purpose of the correction, we can replace π_π by $\pi_0\rho_1/\rho_0$. We have then what amounts to a simple equation in ρ_0/ρ_1; its solution is $\rho_0/\rho_1 = l_0/l_1 - \frac{\pi_0}{B}\left(\frac{l_0}{l_1}-1\right)$.

In the value deduced for the osmotic pressure, $\log_e(\rho_0/\rho_1)$, enters as a factor, and the corrected value of this factor is $\log_e(l_0/l_1) - \log_e\left[\frac{\pi_0}{B}\left(\frac{l_0}{l_1}-1\right)\right]$.

The correction for a solution at 0° C., the osmotic pressure of which is 132 atmos., is −0·84 atmos., and for one the osmotic pressure of which is 41 atmos. it is −0·26 atmos.

BERKELEY.

Foxcombe near Oxford.

Chemistry and Industry.

In his admirable article in NATURE of February 18 under the above heading, Prof. Jocelyn Thorpe dealt in a very concise manner with the grave difficulty which must seriously hamper all the present efforts to establish chemical industries in this country in successful competition with Germany. Particularly his remarks that the scientific worker has found by sad experience that little financial profit accrues to him even though he goes to the trouble of obtaining patent protection for his discovery, are of interest.

In this country, when an inventor applies for patent protection, a novelty search is made by the Patent Office in respect of his invention, solely among British patent specifications published before the date of his application during a period of fifty years. In contradistinction thereto the examiners at the German Patent Office investigate all printed publications of the last one hundred years prior to the date of such application. These publications include not only German patent specifications, but patent specifications and text-books of every country in the world. The applicant's attention is directed to any prior publication or text-book dealing not only with the particular subject but containing even remote suggestions that may lead up to that particular discovery.

Now, while this somewhat gigantic problem of the German Patent Office cannot in all cases be efficient and free from fallacy, it is, nevertheless, quite clear that the result of such a search must in a large number of cases be of greater value than that of the limited search carried out by the British Patent Office. In this manner, therefore, the inventor, if his discovery is found novel and patentable in Germany, has not only the satisfaction of having his invention tested quasi from an international point of view, but what is more valuable to him, he has his attention directed to knowledge existing and discoveries made also outside his own country.

Due to this wide scope of the official search, apart from other stringent considerations connected therewith, fewer patents are, of course, granted proportionately in Germany than are granted in this country, and it would, indeed, be interesting to examine how many of the discoveries for which patents have been granted in this country, for instance, in respect of aniline dyes, have, in fact, been protected also in Germany. A number of these British patents on which royalties are probably being paid, or will be paid in the near future, would, perhaps, not stand a test before our courts, since prior text-books or a prior foreign specification may be relied upon in an action before a British Court, while the Comptroller-General of Patents has no right to consider such publications before granting a patent.

I have heard it argued that our limited search was good enough, because if there was anything worth patenting anywhere, it would certainly be patented in this country. I venture to suggest that this is as much an antiquated idea as prevailed, until this war opened our eyes to the present industrial situation, with regard to the industrial supremacy of these islands shortly after the time when Section 27 of the Patents and Designs Act of 1907 was called into being. In this connection it is interesting to recall a famous phrase uttered by Mr. Justice Parker (now Lord Parker) in his decision in the matter of the revocation of Hatschek's patents, Nos. 6455 of 1900 and 22,139 of 1900, viz. :—"However great may be one's belief in the industrial supremacy of the inhabitants of these islands, it would at least be somewhat arrogant to assert that wherever the manufacture of a patented article in the United Kingdom is less than one-half of the total manufacture of the whole world, there arises a presumption that British trade has not had fair play."

The decision involved a matter of great importance to patentees, manufacturers, and British traders, and it was justly stated that the whole industrial world was anxiously awaiting the dictum on that famous section of the Act.

The greatest anxiety, of course, prevailed in Germany, and this was natural in view of the many British patents taken out by German chemists and chemical concerns for the purpose of blocking the industry in this country rather than of developing it.

Now, why has that section failed to do that which it was actually framed for? To my mind there are several important reasons. The average manufacturer does not possess the knowledge that chemical manufacture cannot in these times be carried on without his close co-operation with highly trained chemists, and, true to old-established tradition, he is prejudiced to any such co-operation. Further, he is constantly faced by the danger of infringing existing British patents, and even though he may be aware that the patents blocking his way are mere "paper" patents and that he has every reasonable hope to succeed in an action for infringement or revocation thereof, the exceedingly high cost at present connected with any action must have an important effect on his hesitative

attitude, and largely accounts also for the perpetual success of those whose business it is to defy the section and to maintain their "unworked" patents to the detriment of the British industry.

JUSTIN E. POLLAK.

London, March 4.

Measurements of Medieval English Femora.

PROF. KARL PEARSON'S criticisms are always welcome and stimulating to those strong enough to bear them though, since they are usually of the destructive variety, the fear of them undoubtedly prevents a good deal of work which would add to our knowledge being published. Let me deal, for instance, with the following criticism. "Looking at Dr. Parsons's results I can but conclude that his sexing is based on a fallacy, and the dip he has created in the Rothwell femora between those with 45 and 47 mm. heads—the range of Dwight's doubtful sex—is due to conscious or unconscious selection of his material; out of the great masses of bones available at Rothwell (which should have occupied in measurement of many characters and in their adequate reduction the whole time of a man for four or five years)."

By "conscious selection of material" I can scarcely think that deliberate fraud is suggested—I do not indeed know what it really means; while unconscious selection I suppose is covered by inaccurate measurements or by the absence of bones of a certain size which ought, mathematically, to be there.

At any rate, the impression conveyed by the stricture is that, from an enormous available mass of material, I have deliberately or unfortunately picked out a small selection which would bear out some object which I wished to prove

It is almost inconceivable that Prof. Karl Pearson would have mentioned the "great masses of bones available" unless he really knew what he was talking about, so that we may safely assume that he has been to Rothwell and satisfied himself on this point.

I can only say that I have spent a great deal of time at Rothwell, and that I found considerable difficulty in picking out 300 measurable femurs, and this was particularly the case with the slighter bones which, owing to the damp, snapped like carrots when touched.

I can assure Prof. Pearson that every measurable bone which could be extricated was welcome, and none were rejected because their sizes did not suit.

As to four years of a man's whole time being needed for the research, I can only infer that Prof. Pearson thinks that there is unlimited measurable material at Rothwell, and that, if I could not give the time he thinks necessary, I had better have left it to some other man who could. These really are the words of the "mere mathematician" ignoring all practical details. Did not Prof. Pearson observe when he went to Rothwell that the bones were rotting with damp—exactly the opposite condition, by the bye, to his Naquada bones—and that the farther he worked into the stack, for he must have done this or how would he otherwise have known about the "great masses of bones available"? the more sodden and useless the material became? As no one else showed the least sign of spending even four weeks in working at the Rothwell bones, I did what I could while I could, for if I had left it for another ten years the available material would have been much less. Incidentally, I advised the restacking of the heaps, so that air now gets among the bones, and they will not disintegrate so rapidly. There is another practical point, too, about which Prof. Pearson is silent; it is the fact that the ordinary anatomist has difficulty in getting unlimited measurements recorded, and my contribution of sixteen sets of measurements on nearly 300 bones was all I could fairly expect our journal to print for me at one time.

In other points I think that Prof. Pearson and I are in practical agreement. We agree that neither of us can sex femurs with accuracy (I find that in eighty-two attempts I made seven mistakes), but that, when we have sexed them to our individual taste, the average difference in results is a fraction of a millimetre. We both agree that the head measurement alone is often liable to mislead, and that a series of secondary sexual tests of graded value are needed. These I have attempted to provide in a paper which will appear shortly, and of which I will not fail to send Prof. Pearson a copy.

Above all, I am glad to see that he tacitly agrees with me about the Rothwell bones being medieval, probably of the fourteenth and adjacent centuries.

F. G. PARSONS.

St. Thomas's Hospital, S.E.

The Green Flash.

PROF. PORTER'S interesting letter (NATURE, February 18, p. 672) on this subject must be my excuse for sending a summary of my own experience during the last eighteen years in which I have observed the flash more than a hundred times, and in no single case did I find anything not explainable by atmospheric dispersion, nor anything that could be put down as a subjective or complementary after-image.

I may add that I have observed with the naked eye, with an opera-glass (power 3), with binoculars (power 9), and with a telescope (power 100).

Whenever on a clear day a low sun is observed through a telescope, the upper limb appears bordered with a marine, *i.e.*, blue-green, fringe, the lower with an orange-red fringe, the side-limbs are unaltered. (The telescope should have a solar diagonal and other means of reducing the brightness of the sun.)

The marine upper fringe develops ultimately into the green flash, the blue element weakening as the sun descends. I have watched this change with the telescope, and it is perfectly continuous.

Again, if the sun descends behind a low cloud, parallel to the horizon, but with a clear space between, the base of the sun, just as it becomes visible, shows the red flash. I have seen this only thrice, as the necessary conditions are obviously seldom satisfied. The red flash seems inexplicable save by dispersion.

Under favourable conditions at sunset, as the upper segment of a yellow sun gradually diminishes, the right and left corners of the segment become green; this colour gradually spreads inwards, becoming marine, until finally the last tip of the sun may appear almost greenish-blue, and just as the sun has sunk, a very faint wisp of blue light is glimpsed directly above the point of disappearance. One friend even records a violet wisp.

But when the sun is orange the blue is replaced by green, and when the sun is really red no green flash at all is seen, the atmosphere cutting off the green as well as the blue rays. To see these changes it is desirable to use a power of 8 or 9.

Prof. Barnard, writing to me some years ago, said he preferred the title, "blue flash," as in sunsets seen over the Pacific from the Lick Observatory the final flash was usually blue. Doubtless this is due to clear atmosphere.

It is well known that at sunrise, when no exciting colour can be present, the flash has been seen, sometimes green, sometimes blue.

In the 1906 volume of *Symons's Meteorological*

Magazine appears correspondence on this subject by Dr. Rambaut, myself, and others, and the editor, Dr. Mill, in summing up the matter, decided strongly in favour of the dispersion theory. Capt. Carpenter, R.N., whose numerous observations appear in the *British Astron. Assoc. Journal*, holds the same view.

It is quite true that, if I look steadily at a bright red sun, and then close my eyes, I see a green after-image, but this is just what the observer of the green flash should not do. He should avoid looking at the sun when it is bright, and should wait until it is so low that the eye can easily bear the light—should wait, in fact, until only a very small segment is visible. As before stated, with a really red sun the flash fails to appear, so far as my experience goes. If proper precautions are taken I do not think any appreciable after-image will be present.

I may point out that the nature of the horizon, provided it is clean-cut and low down, makes but little difference. It may be of cloud, land, or water, and, of course, the last is the best. My experience relates to all three.

But few persons appear to have used a telescope for observing the flash. If those who have not done so would observe a low sun with a power of, say, 100, I think that they would be convinced that the true cause was atmospheric dispersion.

The real mystery about the flash is that it so often fails to appear, when apparently all conditions seem favourable. I have not yet found any explanation of this, but I am inclined to the opinion that at a clear sunset the flash could always be seen if a telescope were available, though it might be too feeble for the naked eye, for a telescope invariably reveals the upper green fringe when the sun is low. The telescope, of course, was achromatic, and showed no colour with a high sun. To the Journal of the B.A.A., to that of the Leeds Astron. Society, and to the *English Mechanic* I have contributed very numerous notes on this subject, but references to them would occupy too much of your valuable space. C. T. WHITMELL.

Invermay, Hyde Park, Leeds, February 22.

The Prices of Chemicals.

I HAVE had the same experience as "S. P." Since my letter of February 18 I have been able to purchase dulcite at 6*os.* an ounce from a firm of dealers in chemicals other than the one to which I referred. I cannot admit, therefore, that my complaint was unjustifiable. J. J.

University of Liverpool, March 2.

THROUGH SIBERIA.[1]

THIS book is the diary of a very interesting journey accomplished by the author in the course of the autumn of 1913. In fact, it describes four different journeys: one from Tromsö, *via* the Kara Sea, to the mouth of the Yenisei; then up the Yenisei to Krasnoyársk; next by rail across Transbaikalia and Manchuria to Vladivostók on the Pacific; and from this port to Petrográd, by the Usuri and the new Amur railway and the main Trans-Siberian line. A remarkable feature of this journey, during which more than 16,000 miles were covered, is that it was accomplished in less than three months, from August 5, when the party started from Tromsö, to October 27, when Dr. Nansen reached Petrográd.

We cannot expect to find detailed descriptions of the different portions of the immense continent thus rapidly crossed; but the book throughout has the greatest interest, owing to the human element it contains, and the unexpected glimpses it gives of the Canada of the East, with its wonderful development during the last fifteen years. In addition, it is illustrated by more than 160 beautiful photographs, taken by the author himself, most of which are worth pages of descriptions. The ethnographical remarks about the northern natives, whose encampments, or boats, Dr. Nansen always found time to visit, especially about the remaining members of that curious, once numerous, nation, the Yenisei Ostyáks, will be read with a special interest; while the photographs, as may be seen from the two accompanying specimens, give a clear idea of the ethnographical types of the different native tribes.

The really difficult part of the journey, from Tromsö to the mouth of the Yenisei, was made on the steamer *Correct*, with the experienced pilot Capt. Johannsen, without meeting with serious difficulties. There was a good deal of ice in the Kara Strait, and especially further east, so that the *Correct* had to enter the Kara Bay in order to follow the narrow, more or less ice-free channel close to the coast of the Yalmal peninsula. There was only one dangerous accident, when the steamer stuck on a mud bank close by the Devil's Island; but otherwise the journey was quite successful, and it took only eighteen days from the day the steamer entered the Kara Strait to the day it reached the port at Nosónovskiye Islands, in the Yenisei, under the 71st degree of latitude.

Once more the practicability of the northern route to Siberia was thus demonstrated. But it must be said that the conditions of ice along the northern coast of Siberia show great variations in different years, and in 1913 they certainly were by far not so favourable as they were in the years 1870–1871 and 1875–1878. A very valuable appendix, where the average summer temperatures on the shores of the Kara Sea and the conditions of ice in that sea are given for the last forty-one years, shows that while this passage was remarkably free from ice in the years named, as well as in 1890, 1897, 1900, 1901, and 1904, the conditions were not favourable for navigation in 1883, 1884, 1888, 1911, and 1913, unfavourable in 1895 and 1902, and most unfavourable in 1903 and 1912.

Still, Dr. Nansen is certain that the northern route may become a regular line of traffic if certain measures are taken. During his journey up the Yenisei, and later on along the Trans-Siberian railway, he had full opportunities to discuss such measures with M. Vl. strótin, a Russian merchant and member of the Duma who has great knowledge of the Siberian north, and also made the journey on the *Correct*, and

[1] "Through Siberia, the Land of the Future." By Dr. F. Nansen. Translated by A. G. Chater. Pp. xvi+478. (London: W. Heinemann 1914.) Price 15*s.* net.

M. Wourtzel, the head of the traffic on the Siberian railway.

"We had," Dr. Nansen writes, "great deliberations in the saloon [of the train] as to how the trade route between Norway and the Yenisei could be best secured, and what were the first steps to be taken to this end. We discussed the best arrangement of wireless stations, the dispatch of motor sloops to investigate the extent of the ice in the Kara Sea, how aeroplanes might be used for constantly reconnoitring the ice-conditions of the sea, in connection with the wireless stations, and so on. The construction of an efficient harbour for discharging and loading in the northern part of the Yenisei and the transport up and down the river were discussed with Vostrótin, who has these questions at his fingers' ends. By degrees a whole programme was drawn up under the shrewd guidance of Wourtzel."

Group of Yenisei-Ostyáks. From "Through Siberia." By Dr. F. Nansen. (London: W. Heinemann.)
(The figures in the background, left and right, are Russians.)

The journey up the Yenisei to the town Yeniseisk, made in a little motor steamer, *Omul*, offered Dr. Nansen the opportunity of making many fine remarks about a variety of subjects—Baer's law of excavation of the right banks of rivers; the first appearance of larches; the exiles scattered even within the Arctic circle and living in tiny primitive huts, the first appearance of agriculture and cattle-breeding, and so on. The rapid change on this journey, from the endless treeless *tundra* to the thick forests region, the gradual growth of the clusters of "snug, low timber buildings," into villages, and further south into towns, and the transition from the isolated native huts to Krasnoyársk, with its gilded cathedral, public park, museum, schools, and electric light in the streets—all the town profusely illuminated to welcome the Norwegian guest—all this, most sympathetically told by Nansen, is fascinating reading.

At Krasnoyársk Dr. Nansen took the luxurious eastern train which brought him in four days, from September 29 to October 4, to Vladivostók on the Pacific. Notwithstanding the rapidity of this journey, we still find in Dr. Nansen's book very interesting remarks about the condition of Siberia, the causes of its slow colonisation, and the rapid strides it has made since the Manchurian war.

Winter was rapidly setting in, and next day Dr. Nansen had already begun his return journey—this time on the railway which runs down the valley of the Usuri to the new town of Khabarórvsk, which I knew fifty years ago as a village of a score of houses. The great railway which is now built by the Russian Government along the left bank of the Amur had not yet reached this new capital of the Lower Amur region. An immense bridge, 7827 ft. long, on nineteen piles, is being built below Khabarórvsk across the Amur; and this bridge, as well as the lowlands on the left bank, representing an immense swamp for some 200 or 300 miles, often inundated during the monsoon rains, offer great difficulties to the engineers. The journey across this marshy

region, as well as the crossing of the Little Khingán, were made by Dr. Nansen, partly in horse carriages, partly in trolleys run along temporary rails, and partly in a motor-car, until he reached, on the Zéya plain, about 420 miles from Khabaróvsk, a station where he could take the direct train to Petrográd. This station, from which Dr. Nansen could now travel by rail all the way to Petrográd, with but one or two interruptions at unfinished bridges, received from the local engineers the name of "Nansen's."

On October 18 Nansen was at Chitá, where he joined the Eastern Express. He passed Irkútsk at night, without stopping; six days later he was in the Urals, and on October 27 he reached Petrográd; and yet, notwithstanding the rapidity of the journey, his observations and remarks about Siberia, "the land of the future," "Russia in the East," and "The Yellow Question," and so on, are both valuable and interesting.

The book is richly produced, with numerous excellent reproductions of Dr. Nansen's photographs, and with three maps—one of the Kara Sea and adjoining lands, and two of Siberia. The transcription of Russian names, both in the text and on the maps, is quite correct, with the exception of a very few words, in which the German spelling has been followed (Tas, Seya, Syriansky, instead of Taz, Zeya, Zyriansky).

P. KROPOTKIN.

Men and women of the Yuraks and Yenisei Samoyedes. From "Through Siberia." By Dr. F. Nansen. (London: W. Heinemann.)

A BIOLOGICAL PUZZLE.[1]

DR. BRUN, of Zürich, has done a fine piece of work in devising an elaborate and ingenious series of experiments which enable us to come to a decision among the rival theories of way-finding among ants. Let us first illustrate the facts. If we pick up one of the higher ants from an ant-road, turn it about in a box, and then empty it out again near the place of its capture, it makes no mistake in hurrying homewards. When an ant goes off alone on an exploring adventure, it often keeps persistently in one general direction, in spite of many divagations to one side or the other, and when it turns its face homewards, it does not usually retrace its steps, but pursues a parallel course until it comes near the nest. If a higher ant, such as *Formica rufa*, be gently but firmly induced to travel on a path chosen for it and not by it, it makes straight for home when freed from coercion. It may run along a line which is the hypotenuse of the triangle the other two sides of which it was compelled to follow, or it may complete a polygonal figure and reach the nest. If members of such species as *Formica rufa* and *F. sanguinea* be lifted up and carried some distance and put down in hunting ground which they have

1 "Die Raumorientierung der Ameisen und das Orientierungsproblem im allgemeinen. Eine kritisch-experimentelle Studie; zugleich ein Beitrag zur Theorie der Mneme." By Dr. Rudolf Brun. Pp. viii+234+51 figs. (Jena: Gustav Fischer, 1914.) Price 6 marks.

not visited for a fortnight, they will return home, quickly, confidently, and by the shortest way.

These are four illustrative facts out of many, and the question is how they are to be interpreted. Some authorities still believe that there is no getting past the assumption of a non-analysable sense of direction, such as the Martian of Du Maurier's novel had of the North Pole. Others have swung to the opposite extreme of taking too simple a view, and maintain that it is altogether a question of scent: ants, like dogs, living in a smell-world. Others again lay too heavy a burden on muscle-memory, and others on visual impressions gathered by the way. Dr. Brun shows clearly, we think, that the power of way-finding is usually a composite product, and that there is no mysterious sense of direction.

Of course, there are ants and ants, and there is no doubt that the scent of the nest, of the food, and of the pupæ sometimes counts for much. If two adjacent sections of a pre-arranged ant-road be lifted and interchanged, the travellers go on just as they were doing; but if a section of the road—say a zinc plate—be lifted and replaced with its ends reversed, the ants seem to be perplexed at the boundaries, and there may be a temporary block. Facts of this sort have given rise to over-ingenious theories of polarised scent, of positive and negative scent, and so forth. This much seems clear, that the nest-smell gets fainter in proportion to the distance from home, and that the food-smell increases as the source of supply is approached; and it is very instructive to find that if an ant of one of the olfactory species be transported and placed in the middle of one of the ant-roads, it does not go home right away, but takes a tentative run first in the one direction and then in the other. In some genera, however, such as Formica, smell counts for little, and the obliteration of the scent by brushing the road or pegging down a spread-out newspaper does not disturb the homing. In connection with smell, it may be noted that the seat of the olfactory sense is in the tips of the mobile antennæ, where tactility is also located, so that tactile and olfactory impressions are closely combined.

To many ants the illumination is much more important than scent, as Lord Avebury proved long ago. He got his ants to make a path across a wooden disc, concentric segments of which could be rotated, and found that if he turned a ring so that an ant on its journey was made to face the wrong way, it righted itself and proceeded in the old direction. But this was not the case when he made the experiment in uniform shade, or when he shifted the light at the same time as he rotated a segment of disc. One of Brun's experiments with a species of Lasius is very instructive. It was marching with the sun directly in its eyes, when the experimenter put an extinguisher over it, and kept it prisoner from 3 to 5 p.m. When it was set free at five o'clock, it turned its back on the position which the sun had reached, moving through 30°, and set off in a straight line homewards, eventually turning sharply to the left to reach its original starting-point. Numerous experiments confirm the view that the direction of the light serves as a compass. When Santschi shut off the sun with a large shade and made a false sun by means of a mirror, he got the ants, even on one of their main roads, to march in a direction either at right angles to the original one, or opposite to it, according to the position of the mirror. If, in the absence of sunlight, there be equal bipolar illumination of a given area, there is in many species no orientation.

From waxing and waning scent and from differential illumination, ants seem to build up associations, but this is not all. There is evidence in some cases of a memory of muscular movements, especially of the distance traversed, as if the ant kept its eye on a pedometer. There is something very interesting, too, in the phenomenon technically known as Turner's curves. A solitary ant that has travelled successfully from a considerable distance reaches a point quite near the nest; but instead of going on confidently, it stops as if perplexed. In many instances—80 per cent. in *Cataglyphis bicolor*—it proceeds to describe concentric curves, it may be for 5–15 minutes, and gradually draws near to the door of its home. Is it seeking for a sign, which might be a shining stone among the sand, or a scent, or the faint stridulation of one of its kin? Is it pursuing a trial and error method, very willing to be helped by any hint or combination of hints?

In some cases, *e.g.*, *Formica rufa*, Brun has proved a baræsthesia, or feeling of gravity. A table was gently tilted, with the nest at the foot of the slope; a feast of honey was placed in the centre; the ants climbed straight up and straight down again. But if, while an ant was supping honey, the table was gently tilted in the opposite direction, so that the way to the nest was up-hill, the ant persisted in going down-hill as before—away from, not towards, home. Among the highest ants Brun finds distinct evidence of definite local memory, based on visual, topographical, and topochemical data, and lasting for two or three weeks at least. And only thus can we understand the confidence with which one of these creatures, transported to a distant part of its range, will make for home. There are ants which trust mostly to scent, and others which are largely guided by the direction of light, but for the higher ants the orientation is a complicated process, the outcome of the registration of manifold imprints received from the outer world—imprints relating to the quantity and quality of scents, the general direction of light, the illumination of particular objects, the slope of the ground, the feel of things, the distance travelled, the turns of the road, the direction of the wind, and even, perhaps, sounds. Individual ants hereditarily endowed with great sensitiveness, hereditarily attuned to receive certain kinds of tidings, serve an apprenticeship in the establishment of associations and reach a degree of perfection probably unsurpassed. Such is Dr. Brun's general position, which he defends

with strong experimental evidence. There are still to be found old-fashioned fishermen who have attained within a certain range to a wonderful seamanship of an empirical sort; they have built up a body of associations from wind and from wave, from the sky and the "feel" of the sea, and they are seldom far out in finding their way home. And so it is with the higher ants, except that they work even more exclusively from an instinctive basis.

It must be remembered that the orientation power of ants does not stand magically alone. Even brainless animals adjust their body in a position of physiological equilibrium in relation to a stimulus of light or warmth or gravity—a static orientation. When there is direction of locomotion in relation to an external stimulus, we speak of dynamic orientation. This dynamic orientation may be direct or indirect. It is direct when the stimulus or goal is within the range of immediate sense-perception, and it must be noted that for ants this range is only about a yard. Of this locomotor orientation there are various grades—tropistic, reflex, instinctive, and acquired, the first three expressing a hereditary predisposition, the fourth expressing the results of the individual's own learning. On a higher level is indirect orientation, where the goal is beyond the range of direct sensory perception. A complex of imprints or memories, corresponding to the goal, functions in the animal's sensorium, and forms the unifying centre of a whole series of imprints of the environment of the goal. What leads the creature on from step to step—often quickly and, so to speak, unquestioningly, if no contradictory interruption occurs—is the recognition of localised stimuli corresponding to those of the unified reference series. The orientation implies a chain of recognitions, and the recognitions imply a registration of individual experiences. Without using Brun's somewhat forbidding mnemic terminology, we cannot do justice to his carefully worked-out theory, but we have indicated its general nature. It is essentially what may be called psycho-biological, for he thinks of the organism as a historic being that trades with time, that enregisters imprints, and that has its past living in its present, as Bergson has accustomed us to say. These imprints, which the individual ant selectively accumulates, are not like sheets filed in a portfolio of reference; they are interpenetrated with and kept alive by their meaning for the actual everyday life.

PROF. JAMES GEIKIE, F.R.S.

BY the death of Prof. James Geikie, Edinburgh and its university have been deprived of one of the most prominent of its men of science, and geology has lost a distinguished investigator and successful teacher. The son of J. S. Geikie, of Edinburgh, whose literary talent found expression in a number of popular Scottish songs, the subject of this notice was educated at the high school and university of his native city, and in 1861, when only twenty-two years of age, received an appointment upon the Geological Survey of Scotland, a service in which his elder brother, Archibald, had already been engaged for five years. James Geikie's work as a surveyor lay chiefly in the south-west of Scotland, and in 1869 he was promoted to be a district surveyor; his studies seem to have been more particularly attracted, from a very early date, to the post-tertiary deposits, and in various papers in the scientific journals, as well as in the official memoirs of the survey, he published the results of his observations and his conclusions based upon them. Early in his career, James Geikie had become a great admirer and warm friend of Andrew Ramsay, then director of the English Geological Survey, and Ramsay's theoretical views and speculative suggestions found a stout supporter in the young Edinburgh geologist. In 1876 the Colonial Office requested Ramsay to proceed to Gibraltar in order to report on the important question of its water-supply, and James Geikie was chosen to accompany and assist him. In addition to the valuable report made to the Government, the two geologists were able to contribute to scientific journals memoirs dealing with the geology of Gibraltar, and especially with the superficial and cavern-deposits, and their bearing on the history of the Mediterranean in post-tertiary times.

In 1874 James Geikie had already published his conclusions concerning the history of the Glacial period in Britain in his well-known work, "The Great Ice Age," which has passed through three editions; and in 1881, after devoting his vacations to travel on both sides of the Atlantic, he extended the bearings of his views on the subject by the publication of his "Prehistoric Europe."

In the following year, however, James Geikie entered upon a new field of labour. The appointment of his elder brother to the directorship of the Survey necessitated his vacation of the Murchison professorship of geology at Edinburgh, and James Geikie received the appointment, resigning his position on the Survey. During his energetic and successful work of teaching, carried on for more than thirty years, he published a number of very valuable educational books: "Outlines of Geology," of which four editions were called for; "Fragments of Earth Lore"; "Earth Sculpture," two editions; and "Structural and Field Geology," three editions. His labours were not by any means limited to the special subject of his studies; he was one of the founders of the Royal Scottish Geographical Society, acting as editor of its journal, and for a time as president of the society. He was also for many years dean of the faculty of science in Edinburgh University. In 1875 he was elected a fellow of the Royal Society, and in 1889 received the Murchison medal of the Geological Society, while he was a member and correspondent of many scientific societies at home and abroad.

It was not only in his numerous scientific writ-

ings that James Geikie's hereditary literary instincts were exhibited, for he published in 1887 a series of translations from the German, "Songs and Lyrics by Heinrich Heine, etc." His frank manner and *bonhomie* won him many friends, and we may well believe that, though an ardent golfer, like so many other Scotchmen, he gave expression to the sentiment ascribed to him that he found a still more pleasant means of recreation in "loafing in pleasant places with a congenial friend." J. W. J.

EMILE-HILAIRE AMAGAT.

BY the death of M. Emile-Hilaire Amagat at his country estate at Saint Satur in the department of Cher, France loses one of her most distinguished physicists. Born in 1840, he held several minor teaching appointments before becoming professor at the École Normal at Cluny. Here in 1867 he commenced his researches into the behaviour of gases under high pressures, which rapidly brought him into the front rank as an experimentalist. At Lyons, where he had become professor at the Catholic university, he utilised the tower of one of the churches as the site for a mercury manometer giving pressures up to 80 atmospheres, and in one of the coal mines of Saint Etienne constructed one up to 430 atmospheres. His observations on nitrogen at these pressures enabled him to use the nitrogen manometer in his experiments on other gases, on liquids and solids, and on the conditions of transition from one state to the other. By the help of a skilled mechanic he had himself trained, he was able to construct apparatus for observations at pressures up to 3000 atmospheres. His results, which appeared for the most part in the *Annales de Chimie et de Physique*, were summarised in memoirs of dates 1883 and 1893, and his curves showing the variation of the value of pv as p increases for hydrogen, nitrogen, and carbonic acid have been reproduced in standard text-books for the last twenty years.

In 1892 Amagat was elected an honorary member of the Literary and Philosophical Society of Manchester, and in 1897 a foreign member of the Royal Society of London. After going to Paris as examiner for admission into the Ecole Polytechnique, he was in 1902 elected member of the Académie des Sciences. In 1906 he was president of the French Physical Society, and soon after was elected one of its few honorary members. Although offered a professorship at the Ecole Polytechnique, he preferred his examinership, and continued to devote to research much of the leisure it allowed him. During the last few years his health kept him at his country house, and for several months before his death he was confined to his room. For a generation he had been one to whom younger men could appeal for advice and encouragement in their work, and many distinguished physicists of to-day recall with affection his kindliness, his sincerity, and his modesty. C. H. L.

NOTES.

THE prospectus of British Dyes (Limited), which was put before the public a few days ago, has evoked universal condemnation in the daily Press. As might perhaps have been anticipated, the board of directors does not include a single representative of science, whilst the directors appointed by the Government consist of a railway director and a civil engineer. This characteristic neglect of science, and its consequences, form the subject of two letters by Sir William Ramsay and Sir Henry Roscoe, published in Wednesday's *Times*. Sir William Ramsay gives numerous instances to show that scientific chemists *must* form an important part of the directorate if the scheme is to be a success. The Castner Kellner process has on its board Sir Henry Roscoe and Dr. Beilby. The ammonia-soda process, originally patented by Dyer and Hemming, was successfully introduced and managed by the late Dr. Ludwig Mond. The paraffin industry was due to the late James Young, at one time an assistant of Prof. T. Graham. Perkin's and Spiller's names are associated with the early days of synthetic colours. These men were both pupils of Hofmann at the Royal College of Chemistry. The firm of Spencer, Chapman, and Messel, which has for many years manufactured sulphuric acid by the contact process, owes its inception and success to Dr. Messel. Turning to metallurgy, Lowthian Bell and Bessemer were scientific chemists first; successful manufacturers after. In short, it would be difficult to discover a successful chemical industry which has not been initiated and controlled by a chemist. Unless "British Dyes (Limited)" copies this precedent, there is little hope for it.

SIR HENRY ROSCOE, in the letter referred to above, points out that it is not the manufacture of the well-known colours of indigo, alizarin, or methyl blue which will bring financial and final success to British Dyes (Limited). The preparation of these articles—which, like all complicated chemical processes, requires both knowledge and great care—is on well-known lines. It is the new thing which makes a business success. "In the colour industry it is then the research chemist, and he alone, who can keep the flag flying, for he alone can bring forward new forces and create new developments. Capital cannot do it, business capacity cannot do it, but the brains, the imagination, the skill, and the knowledge of the research chemist can." Yet though this is the case, so far at least, the research chemist is to have no voice in the direction of affairs in the new colour company, but merely to be called in as an expert when, in the opinion of his business superiors, he can help them to solve some difficulty. If this plan is persisted in and the scientific chemist is not given a voice in the management "success is improbable, if not impossible."

THE Bakerian lecture of the Royal Society will be delivered on Thursday next, March 18, by Prof. W. H. Bragg, upon the subject of "X-rays and Crystals."

WE regret to see the announcement that Principal Sir James Donaldson, Vice-Chancellor of the University of St. Andrews, died on Tuesday night, March 9, at eighty-three years of age.

THE death is announced, in his sixty-fifth year, of Prof. H. W. L. Tanner, F.R.S., formerly professor of mathematics and astronomy at University College, Cardiff.

WE learn from the *Morning Post* that Jean Maspero, the son of Sir Gaston Maspero, the Egyptologist, was killed in the Argonne on February 18 while leading his section into action.

PROF. SAMUEL W. SHATTUCK, for forty-four years professor and comptroller of the University of Illinois, died at his home in Champaign on February 13. Since 1868, says *Science*, Prof. Shattuck served the University of Illinois. For thirty-seven years he was head of the department of mathematics and from 1873 to 1912 he looked after the business affairs of the University.

ON Tuesday next, March 16, Sir J. G. Frazer will begin a course of two lectures at the Royal Institution on the belief in immortality among the Polynesians; and on Thursday, March 18, Dr. Aubrey Strahan will commence a course of two lectures on London geology. The Friday evening discourse on March 19 will be delivered by Prof. G. H. Bryan, on the modern piano-player—scientific aspects, and on March 26 by Sir J. J. Thomson on experiments in slow kathode rays.

WE regret to announce the death on March 6, in his eighty-seventh year, of Lieut.-General J. F. Tennant, F.R.S., past-president of the Royal Astronomical Society. When a young man, Lieut.-General Tennant was assistant to the Trigonometrical Survey of India. He served as Government Astronomer of Madras in 1859, and was afterwards transferred to the Public Works Department as an executive engineer, first, in Burma, then in the Punjab, and later in Bengal. He made observations of the solar eclipses of 1867–68 and 1871, and was in charge of those of the transit of Venus at Rurki and Lahore in 1876.

THE death is announced of Mr. Flaxman C. J. Spurrell, aged seventy-two. For many years he was interested in the geology of the Thames valley and co-operated with his father, the late Dr. Flaxman Spurrell, in collecting Pleistocene mammalia from the river-deposits at Crayford, Kent. In 1880 he described to the Geological Society his discovery at Crayford of a Palæolithic land-surface showing evidence of flint-implements in process of manufacture. The whole of the collection, both of mammalian remains and of flints, was presented to the British Museum (Natural History) in 1893 and 1895.

THE death is announced, at fifty-eight years of age, of Mr. William Willett, the promoter of the Daylight Saving Bill. The Bill proposed that clocks and other timepieces in Great Britain and Ireland should be put on an hour on the third Sunday in April of every year and put back again on the third Sunday in September. Mr. Willett was able to obtain support for this measure from many city corporations and town and district councils, in spite of the serious objections to it, but though the Bill was introduced into the House of Commons on two separate occasions it never reached the final stages. Mr. Willett was a fellow of the Royal Astronomical Society.

THE council of the British Association, in consultation with the local executive committee at Manchester, has decided that the annual meeting of the association shall be held in that city as arranged, in September next. Both the committee and the council have felt that it would be inexpedient under present conditions to offer an elaborate local hospitality in the form of social and other arrangements, which has been extended to the association on former occasions. The committee, however, expressed its desire that the long continuity of the yearly meetings should not be broken, and stated that it would "prefer that the meeting should be held although restricted to its more purely scientific functions."

THE War Office has just published the following table showing the distribution of the cases of typhoid which have occurred in the British Forces in the Field, between the categories of uninoculated, the fully inoculated, and the partially protected:—

	Cases	Deaths
Uninoculated	359	48
Fully inoculated within 2 years (two doses)	111	1
Partially protected (one dose) ...	136	1
Totals	606	50

LORD KITCHENER, Secretary of State for War; Dr. A. Strahan, F.R.S., director of the Geological Survey of Great Britain; and Prof. P. Vinogradoff, Corpus professor of jurisprudence at Oxford, have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public services."

WE learn that no fewer than thirty-seven members of the established staff of the Natural History Museum are at present serving with the naval or military forces, about half of them having joined their units at the front. Among these are Capt. E. E. Austen, who has for many years had charge of the Diptera in the museum; Lieut. C. Court Treatt, assistant in the bird-room, Mr. A. K. Totton, who was recently appointed to the invertebrate section of the department of zoology; Mr. H. F. Wernham, assistant in the department of botany; and Mr. W. N. Edwards, the newly appointed assistant for the study of fossil plants. In addition to the members of the established staff ten temporary assistants and forty-seven sons of the former class have joined the colours, while the museum has also furnished an efficient Red Cross Section and a platoon for the Volunteer Training Corps for Home Defence.

SOME few years ago the buildings of the Aquarium at Rothesay, which was for a time one of the well-known "sights" of the Clyde, were taken over by the Marquis of Bute. The buildings have, through the generosity of the Marquis, provided a local habitation for the Buteshire Natural History Society, of which Dr. J. N. Marshall is president, while they have also served to house a valuable and developing museum collection illustrative of the local fauna and flora. Lord Bute has now installed a small laboratory for biological research and provided the most

necessary equipment, including a motor-boat. Mr. L. P. W. Renouf, of Trinity College, Cambridge, has been placed in charge, and as he is desirous of making the laboratory a thoroughly convenient centre for research work upon the wonderfully rich marine fauna and flora of the Clyde estuary, he will be grateful for the gift of books and pamphlets bearing upon marine zoology and botany. Any such gifts should be forwarded to the Bute Museum, Rothesay, N.B.

THE death is announced, in his seventieth year, of Dr. C. E. Bessey, professor of botany since 1884 at the University of Nebraska. For fourteen years previously he had held a similar post at the Iowa Agricultural College. From 1880 to 1897 he was botanical editor of the *American Naturalist*, and since 1897 he had been botanical editor of *Science*. Prof. Bessey had at various times occupied the presidential chair of the American Association for the Advancement of Science, of the Botanical Society of America, of the Society for the Promotion of Agricultural Science, of the American Microscopical Society, and of the natural science department of the National Education Association. He was the author of "The Phylogeny and Taxonomy of Angiosperms," "Plant Migration Studies," and "Outlines of Plant Phyla," as well as of several botanical text-books for schools.

WE referred in NATURE of February 4 (p. 622) to reports from a number of correspondents that the battle in the North Sea on January 24 was accompanied by much disturbance among pheasants in Lincolnshire, Yorkshire, and even in Cumberland. The disturbance was most noticeable between 9.45 and 10.30 a.m., that is, as we know from Sir David Beattie's report, at the time when the *Blücher* received its principal injuries before sinking. In woods near Burgh-le-Marsh in Lincolnshire, the guns were heard simultaneously with the crowing of the pheasants. Canon Rawnsley, who has collected many reports on the subject, infers that "the pheasant's ear is capable of receiving impressions from sound-waves that the human ear cannot respond to" (*Times*, February 22); but, in a later issue (March 6), Dr. Davison suggests that the disturbance might be caused by the sudden swaying of low trees and undergrowth during the passages of the air-waves. He directs attention to the fact (see NATURE, vol. lxii., pp. 377-9) that, during a naval review at Cherbourg on July 18, 1900, the reports were heard for 107 miles, while windows for another thirty miles were shaken by the inaudible air-waves.

ON Tuesday evening, March 9, Mr. George E. Brown, the editor of the *British Journal of Photography*, at a meeting of the Royal Photographic Society, described a method of colour photography that has recently been worked out at the Eastman Kodak Company's research laboratory at Rochester, N.Y. It is a two-colour method, and as blue is suppressed or represented in only a modified way, the process is not claimed to be suitable for other work than portraiture. The many fine examples shown prove that it gives excellent results, and that the lighter tones, such as those of flesh tints, white kid gloves, pearls, and so on, are particularly well rendered. The darker colours, such as the browns, are very rich, but in the absence of the original materials photographed, it is not possible to say how nearly the colours are imitated. The process consists in taking two negatives, one through a red and one through a green screen, developing and fixing them, then dissolving away the silver image, and staining the films, the red record green, and the green record red. The dyed plates are placed face to face (one is taken reversed to permit of this) and constitute the portrait. It has to be viewed as a transparency, those shown being adjusted in colour for incandescent electric lamps behind a diffusing ground-glass screen or its equivalent. If preferred, the original negatives may be kept as such, and ordinary positives prepared from them. These positives may then be made to furnish any number of negatives for conversion into colour portraits. We learn that the process has already been taken up enthusiastically by American portrait photographers.

THE most interesting contribution to vol. vii., part 4, of the Journal of the Gypsy Lore Society is the first part of an account translated from the Arabic of Father Anastas, the Carmelite, describing the Nawar or Gypsies of the East. The description of them is the reverse of complimentary: "swindling rogues, lewd adventurers, wicked nomads, heedless ruffians," preserving a language of their own but destitute of any religion—the last statement interesting if it be correct. They are believed to be a mixture of Indians, Persians, Kurds, Turks, and Tartars, with the off-scourings of the regions in which they have lived. Their name, Nawar, is, it is suggested a corruption of Lūr, the Persian wanderers who are noted for their skill in thieving, sleight-of-hand, and powers of witch-craft, and they may possibly be ultimately traced to the Indian peninsula. The author writes from personal knowledge of them, and he gives full references to the literature of the subject.

ACCORDING to the *Museum Journal* for September, 1914, a fine piece of art metal-work from the celebrated Dictæan Cave in Crete has found its way to the Philadelphia Museum. It is a unique bronze blade with incised designs, to which the nearest parallel is supplied by the inlaid daggers from the shaft graves at Mycenæ, but these are more elaborate in design and more beautiful in technique. The blade is 6 in. in length and is covered with a fine green patina. It probably belongs to the Late Minoan III. period. On one side a hunter is attacking a mighty boar with a spear, the jungle being indicated by a tuft of fern-like sprays between the sportsman and his victim. On the other side is represented the critical moment of an exciting bull fight, one bull clearly getting the worst of the encounter. Similar fern-like sprays on the quarters of one animal possibly represent the furry lines of his coat where the direction of the hair changes. The museum has also acquired a fine series of reproductions of the gems of Minoan and Mycenæan art—several swords and daggers, gold and silver cups from Mycenæ and Vaphio, faïence objects from the shrine of the serpent goddess at Knossos, and reproductions of some of the frescoes, including the famous cup-bearer.

AMONG the articles in the February number of the *American Naturalist* is one by Messrs. Castle and Fish on the black-and-tan rabbit and the significance of multiple allelomorphs, in which the origin of the breed is indicated.

IN vol. x., No. 7, of the University of California publications on archæology and ethnology, Mr. P. E. Goddard has collected a number of tales and legends of the Chilula tribe, a group of Indians now nearly extinct. The collection is a strange complex of primitive types of belief: animal tales, witchcraft, demonology, folk-medicine, and incidents of social life. It is well that the opportunity has been taken to place on record the language and folk beliefs of a people which in a few years it will be impossible to recover.

A PHOTOGRAPH of the European bison cow and calf in the Zoological Gardens is one of the features in the February number of *Wild Life*. Although this calf is the first of its kind born in the London establishment, cow-bison have produced offspring on more than one occasion in the Duke of Bedford's park at Woburn. In connection with a photograph of Canadian wild geese, Mr. S. J. Wigley states that the omission of these birds from the list of species protected in Alberta is a testimony to their alertness and cunning.

THE report of the Indian Museum for 1913–14 deals largely with last year's celebration of the centenary of that institution, of which a notice has already been published in our columns, and the inauguration of a series of public lectures. Much of the rest relates to administrative details and other matters of purely local interest; and attention has also been directed in NATURE to the biological survey of the Chilka Lake, which is discussed in the report under the heading of field-work. Among noteworthy additions to the zoological collections were specimens from the Chilka Lake, specimens received from the marine survey, mammal-skins sent by the Bombay Natural History Society, and a series of, chiefly fresh-water invertebrate, specimens from Kashmir.

NEW reptiles and amphibians from the Permo-Trias of South Africa are described by Mr. S. H. Haughton in vol. xii., part 2, of the Annals of the South African Museum. Very striking is a fine stegocephalian skull referred to the European genus Trematosaurus, under the name of *T. sobeyi*. A skull allied to Tapinocephalus is made the type of a new genus and species, with the designation *Struthiocephalus whaitsi;* and of two new therocephalians, one is regarded as entitled to represent a new generic type (Trochosaurus). Three dicynodonts are also described as new, in one of which it is shown that the bone in Lystrosaurus hitherto regarded as the exoccipital, really represents both that element and the paroccipital (opisthotic).

THE Journal of the Washington Academy of Sciences for January 19 (No. 2, of vol. v.) contains an interesting paper by Mr. H. S. Graves on the place of forestry among natural sciences. The importance of the forest as a distinct plant society and its connection with botany, plant geography, meteorology, sociology, and engineering is well put forward. In the same number Mr. P. C. Standley describes a new genus of Chenopodiaceæ from Arizona, under the name of Zuckia, which is most closely related to Atriplex.

PROF. H. H. W. PEARSON publishes an account of his observations on the internal temperatures of *Euphorbia virosa* and *Aloe dichotoma* in the Annals of the Bolus Herbarium, vol. i., part ii., 1914. The plants grow on the dry slopes of the Great Karasberg. The stem structure of the Euphorbia is remarkable from the large air cavities in the stem. The Euphorbia attains its maximum external temperature more rapidly than the Aloe, and temperatures as high as 51·5° C. were recorded when the black-bulb registered 65·8° C. On wounding, the temperature of the Euphorbia falls suddenly, and the fall is attributed to the expansion of the pith gases due to the withdrawal of latex. When a rubber pellicle has been formed over the wound by the exuded latex the fall in temperature ceases. In Aloe the lowering of temperature on wounding appears to be due to surface evaporation and the recovery in this case is slow, since there is no protective formation of rubber over the wound.

IN *Knowledge* for January Mr. L. Claremont describes the methods of ruby-mining in Burma, with the aid of a number of photographs, and of illustrations by Burmese artists. He deals also with the red spinels, or "balas rubies," of which a large example, presented to the Black Prince, occurs among the crown jewels of Great Britain. The possible sedimentary origin of the ruby-bearing limestone in Burma has been lately pointed out by Mr. T. H. D. La Touche (see NATURE, vol. xciv., p. 348).

THE *Revue Scientifique*, which continues its fifty-third volume in Paris, publishes (February 6) a lecture given in 1914 by Prof. Stanislas Meunier on "Le problème des montagnes." The author repeats his suggestion that earthquakes may be caused by the explosion of steam, when water-bearing blocks of the earth's crust slip down into regions of high temperature. He declines, however, to look forward, with Termier, to catastrophic displacements of the surface. We may note that the *Revue* invites records of Frenchmen destined for scientific careers, who have fallen, in heroic circumstances, in the present conflict. Two such obituaries are published in the number here referred to.

THE Meteorological Office with its recent *Weekly Weather Report* has issued a summary of temperature, rainfall, and duration of bright sunshine for the past winter, as comprised in the period for the thirteen weeks from November 29, 1914, to February 27, 1915. The temperature for the winter was in excess of the average over the whole of England, the greatest difference occurring in the east and south-east and in the midland counties, where the mean was approximately 2° warmer than the normal. In Scotland there was a deficiency of nearly 1°, and in Ireland the defect for the winter was about 1·5°. The duration of bright sunshine was not very different from the normal, the amount being slightly deficient in the eastern districts,

whilst there was a slight excess of sunshine in the western districts. Excessive rains were recorded over the whole of the United Kingdom, the fall being heaviest over England, where the rains for the whole country were 196 per cent. of the average. In Ireland the rainfall was 152 per cent. of the average, and in Scotland 131 per cent. The greatest excess of rain occurred in the south-east of England, where the measurement, 17·19 in., was 248 per cent. of the normal, whilst in the east of England the record was 228 per cent. of the normal, and in the midland counties 196 per cent. The rainy days were in excess of the average over the entire kingdom, the excess being generally greatest in the English districts.

Symons's Meteorological Magazine for February gives the rainfall for January last at representative stations over the United Kingdom. The total at Camden Square was 4·12 in., which is 2·29 in. more than the average, and is 225 per cent. of the normal. This is the highest percentage of the average at any station given in the table, which, however, is only a tentative representation. Naturally there are many stations given with a larger rainfall, but the normals at these were larger. The map giving the Thames Valley rainfall for January, which in such times of flood as the present is of special interest, shows an area in the neighbourhood of Marlborough with a fall of more than 6 in., and fairly large areas are given with more than 5 in. The rainfall of 4·12 in. at Camden Square is said to be the greatest in January in the fifty-eight years' record, with the exception of January, 1877, when 4·74 in. was measured. Combining the records at Camden Square for the three months November, 1914, to January, 1915, the total measurement is 13·98 in., which is 56 per cent. of the annual average fall, and is 224 per cent. of the normal for the period. The rainfall for January is said to have been above the average over practically the whole of the British Isles, the excess being greatest in the south of England. On the Pennines 8 in. or more fell generally. A copy of a photograph is given showing the flooding of Salisbury Cathedral on January 5 and 6. In the neighbourhood the rainfall measured 16·86 in. from October 13 to December 31, and of this 2·93 in. fell in the last seven days of December, whilst an additional 2·06 in. fell in the first three days of January. The current number commences the fiftieth volume of the magazine.

THERE is a general belief that the paintings of old masters owe their success in some measure to secret processes or lost arts. A paper on the scientific aspects of this question is contributed by Dr. Maximilian Toch to the Journal of the Franklin Institute for January. Among other conclusions, the author points out that the painters only used a limited number of colours (madder being one) the permanency of which was well established, and that they avoided mixing those which were known to undergo chemical combination in each others' presence. As examples of scientific methods of detecting later day copies, some interesting examples are given. The use of zinc white instead of flake white, the presence of protoplasmic remains in the wood cells, and the transparency of the bitumen in the shadows are particular proofs that a picture is not a genuine antique. As regards deterioration, the author alludes to the serious effect of smoke and modern gas fumes, and further points out that while either light or darkness may bleach a picture, some that have been kept in the dark may be restored by placing them in bright sunlight. Finally, Dr. Toch condemns the style of modern painting, which substitutes the collapsible tube or palette knife for the brush, on the ground that the flakes of colour thus attached to the canvas will crack off and become detached. If, therefore, this method was ever used three hundred years ago, no traces of it would now be in existence.

DR. W. C. SABINE publishes an account of a recent lecture to the Franklin Institute on architectural acoustics in the Journal of the institute for January. The investigations referred largely to the lecture hall of Harvard University, in which an ordinary spoken word remained audible for about 5½ seconds. At first they were applied to determine the absorption only of a note of the pitch of violin C, but they have now been extended for three octaves in either sense. By introducing more and more cushions into the room a curve was plotted connecting the quantity of absorbing material with the duration of the sound, and was proved to be very approximately a rectangular hyperbola. Another curve shows that the absorption increases with the pitch. An interesting feature is the diagram showing the distribution of sound intensity in a room with a barrel-shaped ceiling, and though the curves look remarkably complicated, the author finds that it is easy to observe the maxima and points of zero intensity. In conclusion the author says: "While these several factors, reverberation, interference, and echo in an auditorium at all complicated are themselves complicated, nevertheless they are capable of an exact solution, or, at least of a solution as accurate as are the architect's plans in actual construction. It is entirely possible to calculate in advance of construction whether or not an auditorium will be good, and, if not, to determine the factors contributing to its poor acoustics and a method for their correction." It is a pity that these results are not generally applied, so as to prevent public halls being built in such a way that echoes make them almost useless.

M. HENRY LE CHATELIER has contributed an article on explosives to *La Nature* of February 20. In the article the general phenomena of explosion and the methods of measuring the relative value of explosives are discussed, much space being devoted to the phenomena of gaseous explosions. The general questions of the heat developed on explosion, the influence of mechanical forces, of chemical stability, and other minor points are touched upon. In conclusion, it is pointed out that the manufacture and employment of explosives are very complex questions, and demand long study; that in time of war it is not wise to introduce new explosives or great variation in methods of manufacture. Inventors and the public are apt to look more particularly for the production of explosives of enormous power without giving consideration to

other all-important factors governing their production and application.

Engineering for March 5 contains an illustrated description of Lord Chetwynd's electrical steel-purification process, which has been in use for the past eighteen months at the Grimesthorpe Works, Sheffield, belonging to Messrs. Cammell, Laird and Co., Ltd. The steel is manufactured in the ordinary way in the Siemens-Martin furnace, and is then teemed into a special ladle. When teeming steel into a ladle in the ordinary way, a portion of the slag is drawn out with it, and becomes so intermingled with the steel in the ladle that it has no time to separate completely and to rise to the surface before the pouring into the ingot moulds takes place. Lord Chetwynd's process is applied to the steel in the ladle. Two graphite electrodes are made to rest in the layer of slag covering the molten steel in the ladle, and iron electrodes are fitted in the bottom of the ladle. As soon as the graphite electrodes are lowered into the layer of slag an electric current is made to flow through the steel, the effect of which is to raise the temperature of the metal, causing a rotating action throughout the molten mass, with the result that it is freed from the gases and slag particles which it contained in teeming from the furnace. The process lasts about thirty minutes, and the current expenditure is small. Test results show that the process has a marked refining action upon the metal in the ladle.

OUR ASTRONOMICAL COLUMN.

MELLISH'S COMET.—A note in the *Times* of March 10 states that the orbit of this comet obtained by Andersen and Fischer, of Copenhagen, places perihelion passage at about 1 p.m. on July 25 next, the distance being 110 million miles. The comet will remain visible to English observers up to the middle of May, by which time it is likely to be faintly discernible with the naked eye. It now rises about half an hour after midnight, the best time for observation being 5 a.m., when it is a little east of south. Its positions at 5 a.m. on the dates named are as follows:—

	R.A.			Decl.		
	h.	m.	s.	°	′	
March 12 ...	17	39	26	... 0	51	N.
16 ...	17	44	16	... 0	29	
20 ...	17	49	5	... 0	4	
24 ...	17	53	50	... 0	22	S.

THE BRITISH ECLIPSE EXPEDITIONS OF 1914.—The January number (vol. lxxv., No. 3) of the *Monthly Notices of the Royal Astronomical Society* contains the preliminary reports of the various British expeditions which were dispatched last year to observe the total eclipse of the sun on August 21. These reports have now been issued also in a separate pamphlet, and distributed by the secretary of the Joint Permanent Eclipse Committee. Brief accounts of the work of each of these expeditions have already been given in this journal, so attention need only be directed to the handy collective publication mentioned above.

ASTRONOMY IN AMERICA.—With a strong editorial board the National Academy of Sciences of the United States of America has begun a publication of monthly proceedings. These proceedings will be official, and are intended to serve as a medium for prompt publication of brief original papers. It is intended that the papers will be shorter and less detailed than those published in journals devoted to special branches of science, and that they shall, if possible, include an introductory statement of the general aspects of the research, and of its relation to previous knowledge in the same field, so that its significance may be appreciated by those engaged in other branches of science. In the first number (January 15, vol. i., No. 1) astronomy is well represented by the following communications:—The radial velocities of nebulæ, by W. W. Campbell; Preliminary note on nebular proper motions, by H. D. Curtis; Discovery of the ninth satellite of Jupiter, by S. B. Nicholson; Spherical aberration in astronomical objectives due to changes of temperature, by F. Schlesinger; The relations between the proper motions and the radial velocities of the stars of the spectral types F, G, K, and M, by J. C. Kapteyn and W. S. Adams; and, finally, a critique of the hypothesis of anomalous dispersion in certain solar phenomena, by C. E. St. John.

GRUNDSPECTRA OF ALKALI AND ALKALINE EARTH METALS.—A research interesting to spectroscopists is that communicated to the *Astrophysical Journal* for January (vol. xli., No. 1, p. 16), by Mr. Edgar H. Nelthorpe. The work was carried out in the astrophysical laboratory of the Imperial College of Science and Technology, and deals with the observations of the *grundspectra* of alkali and alkaline earth metals. The term *grundspectra* refers to spectra obtained by Goldstein, who used a method by which line spectra of some elements were obtained which were totally different from their arc spectra and could not be arranged in series of the ordinary type. As Goldstein's method appeared in some cases completely to isolate enhanced lines (spark) from the arc lines occurring under the ordinary arc or spark conditions, the author of the present paper has repeated and extended this research, embodying some of the spectra of elements which are represented in stellar spectra. The elements here dealt with are sodium, potassium, rubidium, calcium, strontium, and barium. Mr. Nelthorpe describes the apparatus he employed, and gives the results of each element separately, accompanying them with a series of excellent photographic comparison spectra. The chief conclusion drawn is that the *grundspectra* obtained by Goldstein's method consist essentially of lines which are specially developed in the ordinary spark spectrum. In the case of potassium and rubidium the spectra consist entirely of enhanced lines, but with the calcium group the arc spectrum is not entirely absent.

ELECTRONS IN THE SUN'S ATMOSPHERE.—In a paper communicated to the Tokio Mathematico-physical Society in October, 1914, Prof. H. Nagaoka directs attention to the important part which may be played by calcium in the production of electrons in the sun's atmosphere. In the flocculi so abundant in the photosphere it exists probably as calcium oxide, and the electronic emission of lime when incandescent is frequently utilised in laboratory work. At the pressure of one-tenth of an atmosphere which prevails in the calcium layer about a sun-spot, the electrical conductivity will not be too great to allow of considerable potential gradients which, according to their direction, will establish outward or inward electronic currents of considerable magnitudes. If, as seems most likely, the electric field is directed inwards, the electronic emission will be outwards and the regions of emission will be surrounded by electronic vortices with counter-clockwise rotation. Within the vortices magnetic fields will be produced, and the whole region will possess the properties found to exist in sun-spots. Comparisons of some of the consequences of this theory with observations are, it is hoped, to be carried out by the author and his pupils.

THE CHEMICAL INDUSTRIES OF GERMANY.[1]

THE interest and importance of the subject at the present time are sufficiently obvious. In outlining some of the origins of chemical industry in Germany, the lecturer pointed out how the royal house of Prussia had been frequently associated with chemical enterprise. The Markgrave John was actually surnamed "the Alchemist," the Great Elector was a patron of chemistry and provided a laboratory at Potsdam for the celebrated Kunkel, one of the first to discover phosphorus, and who also effected great advances in the manufacture of glass. Frederick the Great established the Royal Berlin porcelain factory, which still occupies some of the original premises. In the same reign also the chemist Marggraf made those classical investigations on the occurrence of sugar in the vegetable kingdom which later led to the foundation of the beet-sugar industry, which was initially subsidised by Frederick William III., the founder of the University of Berlin in 1809. (In 1914, the Berlin University had 12,585 students, and received an annual grant from the State of more than 200,000*l*.)

Great industries have developed out of these early steps. From the discovery of phosphorus came the match industry. German annual production of matches is 4,600,000*l*.; the British production in 1907 amounted to 775,000*l*., whilst the British consumption in 1910 was estimated at 1,300,000*l*. Again, the porcelain and pottery manufacture had attained great dimensions in Germany, the exports in 1912 amounting to 3,556,000*l*., whilst the glass industry was even on a larger scale, the recent annual exports being more than 7,000,000*l*. Great inconvenience in connection with all scientific work is at present being experienced through the absence of German glass. The important cyanide industry may be said to have taken its origin from the accidental discovery by Diesbach, of Berlin, of Prussian blue in the first decade of the eighteenth century. Germany's annual production of cyanides is now estimated at 10,000 tons (650,000*l*), or about one-half of the world's production.

The present position of Germany in the sugar industry of the world can be appreciated from the following figures :—

Total Sugar Crop, 1912–13.

	Tons
Cane-sugar	9 211,755
Beet-sugar, European (1/3 German) ...	8,310,000
,, United States	624,064
Total ...	18,145,819

The United Kingdom annually imports 1,700,000 tons of sugar (23,000,000*l*.).

	£		Acres
Germany annually produces	36,000,000	beet-sugar on	1,300,000
France ,, ,,	13,000,000	,,	570,000
All Continental countries	116,000,000	,,	6,000,000

The beet-sugar industry is of particular interest in connection with the present crisis because it is an example of an industry which received a most important impetus through the exclusion of British goods (colonial cane-sugar) from Continental ports during the Napoleonic wars.

This industry again exemplifies how agricultural production can be improved by systematic research such as has been bestowed on it by Germany, thus :—

In 1840	100 lb. of beet yielded	5·9 lb. sugar
1850	,, ,,	7·3 ,,
1870	,, ,,	8·4 ,,
1890	,, ,,	12·5 ,,
1910	,, ,,	15·8 ,,

Again in

1871	mean yield of beet per hectare of land was	246 quintals
1910	,, ,, ,,	300 ,,

And again in the economy of manufacture

In 1867	coal used on 100 lb. beet	35 lb.
1877	,, ,, ,, ...	24 ,,
1890	,, ,, ,, ...	10 ,,
1900	,, ,, ,, ...	7 ,,

As indicating the great and progressive attention devoted to agriculture, Germany's artificial manure bills for 1888 and 1912 were highly instructive :—

	1888. Tons		1912. Tons
Chile saltpetre ...	225,000	...	650,000
Sulphate of ammonia	50,000	...	500,000
Superphosphate ...	250,000	...	1,800,000
Basic slag	250,000	...	2,200,000
Crude potash salts ...	160,000	...	3,000,000
Lime...	—	...	800,000
Other manures ...	500,000	...	500,000
Total value ..	£30,000,000		

The following comparison is also of interest :—

Use of Artificial Phosphatic Manures (per annum).

England	48 lb. per 1 acre cultivated
France	105 ,, ,,
Germany	105 ,, ,,

The former supremacy of Great Britain in the manufacture of the common chemicals—sulphuric acid and soda—was referred to, and compared with the production of these materials in 1910.

Production in Tons, 1910.

	Germany	England	France	U. States	World
Sulphuric acid	1,250,000	1,000,000	500,000	1,200,000	5,000,000
Soda	400,000	700,000	200,000	250,000	2,000,000

The substitution of the ammonia-soda for the earlier Le Blanc soda process, and of the contact for the time-honoured leaden chamber process of sulphuric acid manufacture, had no doubt greatly assisted both Germany and America in becoming independent of the British manufacture of these chemicals.

During the past twenty-five years the manufacture of chlorine and caustic soda by the electrolysis of common salt (sodium chloride) has been realised and rapidly extended. This process is carried out on a very large scale in Germany, where extensive use is made of liquefied chlorine. The production of electrolytic chlorine is attended with the simultaneous evolution of large quantities of hydrogen gas for which uses have been found; thus, for filling the dirigible balloons upon which such hopes of conquest have been based by Germany, whilst in the oxyhydrogen flame it has been employed for welding, for the cutting even of thick iron structures, and for the manufacture of artificial gems. The artificial production of gems—corundum, ruby, sapphire, etc.—was discovered in France by Michaud, Verneuil, and Paquier, and has been greatly taken up by the Elektrochemische Werke at Bitterfeld, in Germany. More than a ton of these gems, which are identical in chemical composition with the natural gems, are said to be annually produced. Other more important uses for hydrogen have been found for the hardening of fats, and still more recently for the synthetic production of ammonia to be presently referred to, and which is an industrial achievement of the first magnitude. Cheaper sources of hydrogen than the electrolytic method have been

[1] Abstract of a lecture delivered before the Society of Chemical Industry (Birmingham and Midland Section), in the University of Birmingham, on March 4, by Prof. Percy Frankland, F.R.S.

introduced, and notably that depending on the production of water-gas (consisting of equal volumes of hydrogen and carbon monoxide) from steam and coke at a red-heat, the carbon monoxide being subsequently separated from the hydrogen by liquefying it by means of the low temperature apparatus of Carl von Linde, of Munich.

The discovery of incandescent gas lighting by the Austrian, Count Auer v. Welsbach, and of the metallic filament incandescent electric lamp by the same inventor in 1903, as well as the improvements in the latter effected by Siemens and Halske in 1905 and 1906, have led to the production of these commodities on a very large and increasing scale in Germany, thus :—

	1911	1912
Incandescent gas mantles	126,000,000	135,000,000
Metallic filament electric lamps ...	47,000,000	76,000,000
Carbon filament lamps (production diminishing)	25,000,000	21,000,000

The following comparison of the estimated consumption of incandescent gas mantles in different countries for the year 1912 is interesting (Vivian B. Lewes) :—

Germany ...	100,000,000	Belgium... ...	3,500,000
America ...	60,000,000	Italy	3,000,000
England ...	38,000,000	Russia	1,500,000
France ..	16,000,000		

Ammonia, Nitrates, and Fixation of Free Nitrogen.

During the past century the world's supply of ammonia has been almost exclusively obtained as a bye-product in the manufacture of gas, and latterly also from coke-ovens. So backward was Germany in the production of ammonia that as late as 1874 the ammoniacal liquor of their gasworks was allowed to run to waste. All the more remarkable is the state of affairs revealed by the following figures :—

	Tons
In 1890 the world's production of sulphate of ammonia	210,000
1900 " " " "	500,000
1912 " " " "	1,330,000
1910 Germany's " " "	300,000
1912 " " " "	400,000

The principal use of sulphate of ammonia is as a nitrogenous manure, as which it competes with Chile saltpetre (sodium nitrate).

Sulphate of ammonia contains 20·5 per cent. nitrogen
Chile saltpetre (sodium nitrate) 15 " "

It has already been pointed out that Germany imports 650,000 tons of Chile saltpetre for manure, hence by increasing their output of sulphate of ammonia they have been rendering themselves less dependent on foreign products (nitrate from Chile and sulphate of ammonia from England).

As is well known, one of the most important problems at the present time is to provide the world with nitrate when the deposits in Chile shall have been exhausted. The problem is bound up with the still wider one of the fixation of atmospheric nitrogen. This again, as is well known, is now accomplished on a large scale by the production of nitric acid from atmospheric nitrogen and oxygen by means of the electric furnace of Birkeland and Eyde, or by the production of calcium cyanamide by passing atmospheric nitrogen over heated calcium carbide. Both these processes involve the use of the electric furnace, in the former for effecting the union of the nitrogen and oxygen, and in the latter for the preliminary production of the calcium carbide. Abundant water-power being necessary for the economic operation of the above processes, Norway has become their chief centre, whilst Germany has sought other means of nitrogen-fixation which could be carried on within her own territories. The synthesis of ammonia from hydrogen and atmospheric nitrogen under a pressure of 200 atmospheres and at 500° C. in the presence of a catalyst, has been successfully worked out by Haber in conjunction with the Badische Anilin und Sodafabrik, and a plant capable of yielding 130,000 tons of sulphate of ammonia per annum was to have been ready in 1915. The second step in the German programme was to convert the ammonia into nitric acid by burning it in air in the presence of a catalyst. In this way it is hoped to make Germany independent of foreign countries for the nitrate required in the manufacture of explosives. It is asserted that this independence Germany has actually secured at the present moment.

Potash Salts.

The unique deposits of potash salts discovered at Stassfurth in 1857 have been exploited on an increasing scale and have furnished practically the whole world with potash; the output of crude salts was in

	Tons	£
1881	2,000	
1912	11,000,000 ...	... (8,800,000)

In 1911 America alone took potash salts to the value of 3,000,000*l.*

Explosives.

Of the modern high explosives, gun-cotton was discovered by Schoenbein and by Boettger in 1846. The manufacture of nitroglycerine (discovered by Sobrero in Paris in 1847) was first realised by the Swede, Alfred Nobel, in 1862, and it was Nobel who first adapted these powerful explosives for ballistic purposes. Trinitrotoluene, of which so much has been heard recently, was first proposed for filling shells by Haessermann in 1891. It is said to be surpassed, both as regards safety and disruptive effect, by tetranitro-aniline discovered in England by Dr. Fluerscheim. The great magnitude of the German explosives industry is seen from the following figures :—

	Tons
Total German production of explosives ...	40,000
or about 1/10th of the estimated world production.	
	£
Germany exported in 1908 to the value of	1,000,000
" " 1912 "	3,000,000

Artificial Silk.

This remarkable industry, originated by Count Chardonnet in France in 1891, has also been largely developed on German soil. The German production amounts to about 2000 tons annually (1,200,000*l.*) out of a total world production of about 7000 tons. French, German, and British patents have largely contributed to the success of this industry.

Industries Dependent on Synthetic Organic Chemistry.

It is in respect of these industries that the world is learning that Germany holds the undisputed supremacy. It is in Germany alone that manufacturers have been found prepared to embark their capital and undertake industrial enterprises of the first magnitude on the advice of the organic chemist. The success which has been achieved by the German manufacturers of artificial dyestuffs, drugs, and perfumes, and the hegemony which they have secured in this branch of industry, has been the frequent subject of warning by professors of chemistry in this country for upwards of a generation. The seriousness of the situation which has arisen through the neglect of those warnings is seen from the following figures :—

	£
Annual value of dyestuffs used in England ...	2,000,000
,, trade in which these dyes are employed	200,000,000
Workmen dependent on this trade 1,500,000	
Total value of dyestuffs imported (1913)	1,892,055
,, ,, ,, from Germany	1,730,821

Thus less than 1/10th of the annual value of the dyestuffs consumed in England is produced in this country. Thus, by controlling the dyestuff industry, Germany indirectly holds in her grip the much larger textile industry.

The manner in which the coal-tar colour industry has extinguished the cultivation of madder more especially in France, since 1870, and has caused the cultivation of indigo in British India to dwindle almost to nothing since 1897, are now well-known facts in commercial history. They will be fully appreciated by a study of the following figures:—

At the time of the discovery of artificial alizarin (the dyestuff contained in madder) in 1869, the total production of natural alizarin amounted to between 500 and 750 tons (2,250,000*l.*), and in 1870 France had 50,000 acres under madder cultivation.

The production of artificial alizarin was

	Tons
In 1873	100
1877	750
1884	1350
1900	2000

(4/5ths of this produced in Germany).

Again, with regard to indigo, in 1896 the world's production of plantation-indigo was valued at about 4,000,000*l.*, of which four-fifths were obtained from British India.

Export of Indigo from British East Indies.

	£
1896	3,569,670
1899	1,980,319
1902	1,234,837
1905	556,405
1908	424,849
1911	225,000
1913–14	60,000–70,000

Since the introduction of artificial indigo the price of indigo has been reduced by more than one-half, but since the outbreak of the war the price of indigo has advanced by 350 per cent.

Much inconvenience has been experienced also in the shortage of artificial drugs and consequent high prices, more especially at the beginning of the war, as even the simplest of these products were almost exclusively made in Germany. The manufacture of some of these is, however, now being successfully carried on in England.

Again, the shortage of organic chemicals required for research purposes, which practically all come from Germany, is occasioning most serious difficulties in our university laboratories.

For the manufacture of dyestuffs and similar synthetic products Germany was formerly largely dependent on England for the raw material—coal tar. But in this case, again, the ambition of Germany to become in all respects independent and self-contained has led her in recent years to make the most strenuous efforts to recover the maximum amount of coal-tar both from the manufacture of gas and from coke-ovens, which endeavour has been assisted by the enormous growth in her iron and steel industries. Thus in 1897 Germany obtained only 52,000 tons of coal-tar from coke-ovens, whilst in 1908 she obtained no fewer than 632,400 tons from that source, besides 300,000 tons from the manufacture of gas. Thus at the present time the German output of coal-tar about equals, if it does not exceed, that of England.

The German production of artificial perfumes is said to amount to a value of about 2,500,000*l.* annually. In this department of applied chemistry, again, one of the first steps was made by the late Sir William Perkin, by the synthesis in 1868 of coumarin, the much-valued odoriferous principle of woodruff (*Asperula odorata*).

The great magnitude of the German coal-tar colour industry may be gathered from the fact that the two groups into which the principal firms are associated have at the present time a total share-capital of about 12,000,000*l.*, on which a dividend of about 28 per cent. is paid. In 1912 Germany produced dyestuffs to the value of 12,500,000*l.*, of which to the value of 10,000,000*l.* were exported.

The proposal of the Government to assist the British coal-tar colour industry is being watched with the greatest interest both by manufacturers and chemists. The problem of relieving the immediate shortage during the war must be carefully distinguished from the later problem of securing the independence of the home-industry after the war by greatly increasing the British output. The realisation of the latter object will be attended with the greatest possible difficulty. The industry will require "nursing" for a great many years. The undertaking must be possessed of such elasticity that it can ramify into other branches of chemical or other industry whenever advantageous opportunities arise for such departures. Chemists must form an integral part of the directorate, which must be prepared to spend large sums of money on judiciously conceived and well-organised research, for which the sum of 100,000*l.* in ten years, hitherto mentioned by the Government, is ridiculously inadequate. The undertaking must, moreover, be freed from all hampering legislation with regard to restrictions in the use of alcohol, ether, chloroform, and other chemicals. In short, the rehabilitation of the industry in this country will not be effected by following the precept "business as usual," but by pursuing a policy which is quite the reverse of what is implied by that undignified phrase.

BRITISH ASSOCIATION DISCUSSION OF THE NATURE AND ORIGIN OF SPECIES.

AN outstanding feature of the Melbourne meeting of the British Association was the joint debate by Sections K and D (Botany and Zoology) on the nature and origin of species. Prof. F. O. Bower, President of Section K, took the chair.

Dr. A. B. Rendle pointed out the need of a working unit for the classification of the world's flora. A working systematist or monographer recognised certain characters common to a number of individuals as limiting varieties, species, and genera from one another. Such expert work was difficult, and inclined to be at times individualistic, but was necessary if systematic botany was to exist. Dr. Rendle showed himself a thorough supporter of the well-known Darwinian explanation of the origin of species by natural selection. The living organism is eminently adapted to its environment or is epharmonic. Slight gradual changes in the organism due to internal causes, influenced or not by slight changes in environment, accumulate and become inherited. If these changes are pronounced, *e.g.*, sports or monstrosities, they are likely to be detrimental to the individuals possessing them. To grow plants under alien conditions generally requires care and freedom from competition. He thought experiments con-

ducted under control in the laboratory or greenhouse partook too much of the nature of hospital treatment, and that conclusions based on such work were scientifically unsound. The open field of nature was the more trustworthy as the interplay of forces there had nothing personal in it. He could not accept the theory offered by De Vries and others of the origin of species by mutation, namely, by the inheritance of striking changes suddenly appearing, that is to say, discontinuous variations, as distinguished from the non-heritable fluctuations of slight degree. The inheritance of the discontinuous variations gives rise by a process of segregation to the elementary species of De Vries. The Darwinian species arises, on the contrary, by selection by an aggregation of slight gradual epharmonic changes.

Dr. Rendle took as an example of the difference of interpretation under the two opposing views the work of Jordan on the Drabas and of Wettstein on alpine meadows. He showed no sympathy for Lotsy's view of the origin of species by crossing. The resulting forms would be in 90 per cent. of the cases of the nature of monstrosities, and incapable of perpetuating themselves. They would be too, as regards environment, unharmonic. In conclusion, he considered the latest suggestion made by Prof. Bateson, that new forms arise by the omission of a character, to be full of difficulties. On this view the highest phase of evolution would correspond with the disappearance of all characters, while the primitive organisms must have been inconceivably complex.

Prof. A. Dendy, President of Section D, considered that species arise by a process of fundamental evolution, in which environment plays a leading part, and that the adaptations are inherited. The epigenetic characters are, however, modified by sexual reproduction, giving permutations and combinations, following Mendelian laws, which are superposed on the modifications due to Darwinian evolution.

Prof. W. Bateson, President of the Association, did not himself attach so much importance as some of the speakers to the standardisation of the term species. He thought it hopeless to expect definite conclusions as to the nature and origin of species along the lines advocated by Dr. Rendle.

The reason that unquestionable judgments could not be reached was obviously that the physiological nature of specific difference was still unknown. In the absence of this knowledge the delimitation of species must be arbitrary. Many, following Darwin, hold that the distinction between species and variety was a matter of degree. That might be so, but he (the speaker) inclined to doubt it. No one, however, as yet had evidence on which a confident opinion as to that fundamental point could be based. Such evidence, if indeed attainable, could be reached only by physiological experiment—experiments in breeding providing as yet the most hopeful line. No amount of inspection of specimens, living or dead, could decide specific limits. Names must, of course, be given, and freely. Systematists perhaps do well to indicate which names they regard as prerogatively specific; but it should clearly be understood that these decisions were pragmatical and matters of convenience, and they should not be offered as indications of physiological significance.

Prof. E. B. Poulton thought there was too much assumption in the distinction drawn by De Vries between his non-heritable fluctuations and his discontinuous heritable variations as regards their heritability. He (Prof. Poulton) agreed with Prof. Dendy in laying stress on the importance of sexuality in producing new patterns by the endless combinations of units. He thought environment alone was not enough to account for the production and continuance of a variety. There must be selection too.

Prof. Benjamin Moore caused his audience much amusement by stating that although he had been compared in the President's address to Harry Lauder's schoolboy who took from his pocket a washer and said "that's to mak' a motor-car," yet if he were starting to collect materials for building a motor-car he would rather begin with a washer than a pot of enamel paint. Workers at different levels on the subject of evolution were apt to despise one another's work or misunderstand it. The problem of the origin of species, just like the problem of the origin of atoms, was fundamentally a chemical problem, and in its study the effects of energy transformations acting from without upon the living cell acting as a catalyst must be taken into account. The outside sources of energy formed the environment, and this environment acted as a directive, screening, and selective factor causing small variations.

Prof. E. A. Minchin said that speaking quite generally and ignoring for the moment intermediate and transitional forms, he believed that two principal grades of evolution would be recognised in the Protista, exemplified by the Bacteria and Protozoa respectively. In the bacteria the full structure of the cell has not been attained, and there are no sexual processes. In the Protozoa, on the other hand, the individual is a complete and typical cell, and sexual phenomena occur. In the bacteria the so-called species are groups of individuals in which the variability is indefinite and uncontrolled. In the Protozoa the variations are reduced to a common level by sexual blending, and fixed species occur. He believed that in the unicellular Protista one of the effects of the sexual powers is to produce true species by controlling and levelling down variability.

Mr. J. T. Cunningham expressed the view that recent discoveries concerning internal secretions or hormones gave evidence of a physiological process which would make the transmission of functionally produced modifications possible.

Dr. F. A. Dixey thought that the principle of segregation of the gametes, especially as reinforced by the President's suggestion of "fractionation," has thrown light on the persistence of some forms and the appearance of others. It would seem that adaptation can only be satisfactorily accounted for on the basis of selection applied to small inheritable variations.

Mr. R. P. Gregory and Dr. G. C. Druce also spoke. T. J.

FORTHCOMING BOOKS OF SCIENCE.

IN addition to the forthcoming books of science referred to in recent issues of NATURE we notice the following publishers' announcements:—*D. Appleton and Co.*—The Fundamentals of Plant Breeding, J. M. Coulter; Psychology, General and Applied, H. Munsterberg; Sanitation in Panama, W. C. Gorgas. *The Cambridge University Press.*—The Teaching of Mathematics, Prof. T. P. Nunn (Cambridge Handbooks for Teachers). *J. M. Dent and Sons, Ltd.*—An Introduction to the Study of African Languages, Prof. Meinhof, translated by A. Werner; Elementary Experimental Statics, I. B. Hart. *G. G. Harrap and Co.*—Scientific Management in Education, Dr. J. M. Rice; An Industrial Geography of Britain, W. J. Claxton. *T. C and E. C. Jack.*—German Culture, edited by Prof. W. P. Paterson, the aim being to give an estimate of what Germany has contributed to higher life and thought in the various departments of knowledge. The fol-

lowing subjects will be dealt with, among others:—German Science, Prof. J. Arthur Thomson; German Philosophy, Prof. A. D. Lindsay; Political Philosophy and Politics, Prof. D. H. Macgregor; German History and Character, Prof. R. Lodge; Modern Inventions, V. E. Johnson; Electricity, W. H. McCormick; Engineering, G. Knox. *Longmans and Co.*—The Development and Present Position of Biological Chemistry, Prof. F. G. Hopkins; The Polysaccharides, A. R. Ling; Colloids, W. B. Hardy; Respiratory Exchange in Animals, Dr. A. Krogh; Protamines and Histones, Dr. A. Kossel; Organic Compounds of Arsenic and Antimony, Dr. G. T. Morgan; Lecithin and Allied Substances, Dr. H. Maclean; The Ornamental Plant Pigments, A. G. Perkin; Chlorophyll and Hæmoglobin, H. J. Page (Monographs on Biochemistry); Electric Waves, Prof. G. W. Pierce; The Emission of Electricity from Hot Bodies, Prof. O. W. Richardson; Colloidal Solutions, Prof. E. F. Burton; Atmospheric Ionization, Prof. J. C. McLennan (Monographs on Physics); Electrolytic Dissociation Theory, Dr. J. C. Philip; The Physical Chemistry of Flames, J. E. Coates; Clays, Dr. J. W. Mellor; Catalysis of Gas Reactions, D. L. Chapman; The Electro-Chemistry of Non-Aqueous Solutions, J. W. McBain; Catalysis in Liquid Systems, Dr. G. Senter; Hydrates in Solution, Prof. E. A. Washburn; The Rare Earth Metals, Dr. J. F. Spencer; The Molecular Volumes of Liquid Chemical Compounds, G. Le Bas; Adsorption, V. Lefebure and A. M. Williams (Monographs on Inorganic and Physical Chemistry). *J. Nisbet and Co., Ltd.*—The Operative Treatment of Chronic Intestinal Stasis, Sir W. A. Lane. *Sir Isaac Pitman and Sons, Ltd.*—Experimental Physics, A. Cowling. *T. Fisher Unwin.*—Rubber Recueil: Papers on Rubber, its Botany, Culture, Preparation, and Commerce.

THE SECOND INDIAN SCIENCE CONGRESS.

THE second Indian Science Congress was held in Madras from January 14–16. It may be remembered that the suggestion to hold a Science Congress in India on the lines of the British Association was first made some three years ago by Prof. MacMahon, of Lucknow, and Prof. Simonsen, of Madras. The first meeting was held a year ago in Calcutta.

The Hon. Surgeon-General W. B. Bannermann, I.M.S., C.S.I., was president this year, and delivered on address entitled "The Importance of a Knowledge of Biology to Medical, Sanitary, and Scientific Men Working in the Tropics." After dealing with the scourges of India and recent research as to the nature of plague, malaria, and so on, the president remarked:—"It has been said that Indians have not yet distinguished themselves as they might in the domain of medical research. That is no doubt true, but the reason is not far to seek. The leisured and wealthy classes in India do not send their sons to our universities in any numbers, and when they do, certainly not with the idea that they should spend the rest of their lives in pure research work. Let us hope they will do so some day. It is, therefore, among the sons of the middle class and often poor community that we must look for the men with capacity and inclination for such work.

"But these are the very men who, not being in independent circumstances, must earn their living at the earliest possible time. They cannot, therefore, be expected to engage in scientific research which does not bring in money for daily bread or lead up to any permanent appointment. I would, therefore, appeal to our wealthy Indians to endow medical research, so that their poor but capable fellow-countrymen may have something to look forward to as reward for scientific toil. There are plenty of subjects for research which ought to be endowed, chairs in our medical schools and universities that ought to be established. All our Indian universities are at present mere skeletons; will no one here take up the rôle of beggar and try to extract a few lakhs of rupees from the hoards of his wealthy and aristocratic friends? We know that there is plenty of money to be had when the heart of the nation is touched, as witness the magnificent response to the appeals made for war funds by H.E. the Viceroy and our own Governor of Madras. It must be your part, gentlemen of light and leading, to inspire similar enthusiasm in the good cause of university endowment. India wants to have, not only more chairs and lectureships endowed, but also research scholarships or fellowships established; fellowships available for the student and the research worker, so that he may live in reasonable comfort, and be able to devote his whole energy to the work without anxiety for those depending on him.

"I should like here to point out that we in Madras have made a beginning in this direction owing to the enlightened liberality of the Rajah of Pithapuram, who has presented 50,000 rupees for the expenses of an inquiry into diabetes, that fell disease which carries off so many of the best brain workers in this part of India. This is an example which I trust will often be followed in the future; it can lead to nothing but good for India and her peoples.

"You will remember what our late beloved King-Emperor said with reference to tuberculosis:—'If preventible, why not prevented?' We may say the same of all these diseases—'They are preventible; why are they not prevented?' For their prevention we require research and research workers. Research workers are, after all, human beings and must be able to support themselves and their families by their labours. Who will come forward and help us? India needs this help, and we cannot look to Government for more than a small part of the money required. Government has done magnificent work of late years in establishing laboratories, and subsidising research all over the land, but much more is required. We want scholarships and fellowships with pensions for our best research workers. Endowments for this purpose will do more to keep alive the memory of the donors than the erection of chattrams or other traditional forms of charity. It will not merely do this but will confer an inestimable benefit on the inarticulate millions of India, who do not even know that they can be delivered from the various diseases that afflict them, and are scarcely conscious of their existence.

"But we not only require research workers, we want an organisation that will help to educate the people in the ordinary rules of health. There should be in each presidency an official whose business it is to look after the hygienic education of the common people. He should be in charge of a Bureau of Public Health, and his work should consist in preparing pamphlets and popular lectures with lantern-slide illustrations, which could be lent to lecturers who would undertake to itinerate in the villages and talk to the common people. He should organise classes for the teachers in our teachers' colleges, and he should gather together and popularise information from every quarter. Such an official—who would have to be very specially selected—would do an immense amount of good in educating the people, and without education we can hope for very little advance along the road to health.

"Until the usefulness of such a bureau is fully established, we can perhaps scarcely expect much help from Government, for it has plenty to do with the public revenues, but I am quite sure they would view any endeavour to educate the masses with a sympathetic eye."

After the presidential address it was decided to hold the 1916 meeting in Allahabad, and Dr. W. N. F. Woodland was appointed the local hon. secretary.

In the Agriculture and Applied Science Section Dr. H. H. Mann, of Poona, presided, and his address dealt with "The Lines of Development of Indian Agriculture."

Agriculture in India, he said, is of two kinds. On one hand you have an extensive agriculture, conducted without much capital, with primitive implements and methods, and yielding poor results when compared with any Western standard. On the other, you have a number of comparatively small, but highly organised industries, conducted largely by planters, growing special valuable crops, with adequate capital, and yielding exceedingly high returns.

It is not generally realised how unsatisfactory the results of the average Indian agriculture really are. We have no census of production in India as yet, and really satisfactory figures are not possible. But in a few cases it is possible to give figures which make us realise the position. In wheat production, for instance, the yield per acre is certainly not more than ten bushels per acre, and is probably nearer eight, or one-third of what might be considered as a good crop; more especially in this case where so much of the land devoted to it is irrigated and hence not dependent on a very variable rainfall. In the case of cotton, the figure is equally striking, and in this case the area and production are very fairly well known. From twenty-two million acres, the produce runs to above four million bales, or about 75 lb. of lint per acre, while in America, with an equally uncertain rainfall, the production reaches 200 lb. per acre. Again, if we take an intensive crop grown very largely under irrigation, like sugar-cane, the yield works out at under one ton of raw sugar per acre, as against a world's average of about two tons at least. In this case the average in India is very much lowered by the miserable outturn from Northern India, and the crop in Bombay and Madras is fairly up to the world's average. These figures are so striking that a newcomer to the subject is apt to think that improvement is easy, and that the raising of the standard of this cultivation towards that reached elsewhere is not very difficult.

This, however, is not the case. In no country perhaps is progress more difficult. One is hindered at every point by unexpected difficulties. The lack of anything more than a minimum of capital has been often considered as the most outstanding of these hindrances, and it is very important, though not the only one. The very great conservatism of the Indian cultivators has often, also, been mentioned. In this matter, it may be stated very emphatically that Indian cultivators are not more conservative than their situation demands. When a man is working on a minimum of capital, when any excess capital costs probably from 12 per cent. upwards for interest, when the money is turned over only once or at most twice in a year, it is the only policy to be extremely conservative.

Three methods of investigation seem important with a view of improving matters. One of these is the study of soil physics. It seems very important here, especially as several of our types of soil are peculiar, that the methods of increasing their absorbing and retaining capacity for water under our conditions required very careful investigation. A second investigation, that of implements, is one which is very much needed. A third method, to increase the utility of the water which actually falls in our drier tracts, is the development of drought-resisting varieties of plants.

Mr. F. M. Howlett, in his paper, termed "Chemical Entomology," stated that insects are usually easy to influence by one sense, and one alone. In the case of one small fly a small trace of *iso*valeric aldehyde will bring many thousands of them to a place in a short time, though none were present before. Among the fruit-flies, the maggots of which are found in many fruits, the scent is so well developed and so distinct that each species seems to be attracted by a different smell.

Dr. Coleman, of Bangalore, read two papers on the black rot of coffee, and the "koleroga" disease of the areca palm. He thinks that it is likely that by treatment with Bordeaux mixture black rot of coffee can be checked. The second paper, on the areca palm disease, told the story of one of the very few successful campaigns in India against a destructive disease of the betel nut, which threatened the industry in some districts of Mysore.

In the Physics Section, the contributions of the chairman, Mr. C. V. Raman, on the velocity of restitutions after impact between various elastic materials and his speculations as to the type of air disturbance involved in the click of two billiard balls, aroused a good deal of interest. Among other papers were:—Dr. D. N. Mallik, on a type of electric discharge in the neighbourhood of a permanent magnetic pole; Dr. Royds, on spectrum series; Mr. C. Michie Smith, on the climate of Kodaikanal; Mr. S. Appaswami, the Madras Physics Department, the motion of violin strings; Mr. J. Evershed, of the Kodaikanal Observatory, on sun-spots and prominences. In all twelve papers were read and discussed.

In the Chemical Section Dr. P. C. Ray, of Calcutta, presided, and fourteen papers were communicated. The chairman opened the proceedings by giving a brief account of his recent work on the use of nitrites and chloroacetic acid in causing tautomerisation in certain thio-derivatives, and in a further paper discussed the action of alkyl iodides on dimercuriammonium nitrite. Prof. J. J. Sudborough dealt with alcoholysis, and also gave an account of work which he was carrying on with his students on the replacement of sulphonic acid groups in aromatic compounds during halogenation. Prof. Neogi and Mr. Chowhari described their experiments on the conversion of aliphatic nitrites into nitro-compounds. Prof. Joseph, of Colombo, gave an account of his and Mr. W. N. Rae's work on chromium phosphate. Profs. Gibson and Simonsen communicated two papers on stereochemical problems, in one of which the resolution of β-naphthotetrahydroquinaldine was described.

The Section of Zoology was presided over by Dr. N. Annandale, of the Indian Museum. The two most important papers before the meeting were those on the autotomy and regeneration of the tail in the house-gecko and on the zoanthids of Madras. They were by Prof. W. N. F. Woodland, of Allahabad, and Prof. K. Ramunni Menon, of Madras, respectively.

Dr. C. A. Barber, of Coimbatore, the chairman of the Botany Section, in his opening address, took sugar and the sugar-cane as his subject. The history of the industry in Java was studied in detail as showing a fine example of the application of scientific work to sugar-cane problems. The question whether India (which now imports nearly a million tons each year) could hope to become an exporting country was answered in the negative. It was shown that India was a quarter of a century behind Java, and was, in

fact, only just commencing scientific sugar-cane work. Recent work in India was discussed, especially the efforts to improve the local varieties and the raising of seedling sugar-canes in the newly founded cane-breeding station at Coimbatore. Mr. F. R. Parnell, of Coimbatore, read a very interesting paper on some Mendelian characters of the paddy plant. Dr. W. Burns and Mr. S. H. Prayag described experiments on inarching inflorescence of the mango when a union was made and the fruit of one tree was thus borne on a tree of another variety. Prof. P. F. Fyson discussed the phanerogamic flora of the patana regions of the Nilgiris and Pulney Hills, pointing out the affinities with Ceylon, the Vehasia, and Himalayan regions.

Other papers were by Mr. M. O. Parthasarathy Iyengar, on the defoliation of some Madras trees; by Dr. C. A. Barber and Mr. D. Vekataraman, on the depressed habit in the sugar-cane; and Mr. C. Tadulingam on the Madras flora.

The meeting of the Geological Section was presided over by Dr. W. F. Smeeth, State Geologist of Mysore, who read a paper on the geological history of southern India, and gave an account of the character and distribution of the various components of the great archæan complex as developed in Mysore. Babu H. C. Das Gupta described an occurrence of crystalline limestone from the Daltonganj coalfield. Mr. E. Masillamany dealt with certain basic dykes in Travancore, including gabbro, dolerites, and norites, the petrology and field relationships of which were discussed.

The Section of Ethnography met under the chairmanship of Mr. H. V. Nanjundayya, whose address was on some aspects of ethnographic work. He said that the lower castes are aspiring to a higher status; Gotras are claimed, and customs which enable the observer to recognise the lower caste are suppressed. According to legend the Castes claim descent from God, but actually Castes are considered to be tribal distinctions. By the adoption of Samskaras of higher castes and practising them for several generations higher status is claimed, and renders investigation a matter of considerable difficulty. Dr. Annandale, in a paper entitled "Anthropometric Notes of Calcutta Eurasians," dwelt on the importance of regarding physical anthropology from a zoological point of view. He expressed the opinion that the primary classification of the races of man should be conducted on exactly the same lines that would be adopted in investigating those of any other species. Unfortunately the characteristic features of the different human races were still very imperfectly known, and existing systems of anthropometry were unsatisfactory in many respects. He had no new system to expound, but laid stress on the value of a large series of photographs taken on a definite system and illustrating as far as possible the actual external structure. He put forward a proposal for a photographic survey of the people of Calcutta, and especially of those of mixed race. Dr. Ketkar, of Bombay, read a paper on Indian sociology as a theoretical and applied science. Dr. S. C. Roy read a paper on totem worship amongst the Oraons. The author showed that Kachchapa (tortoise) must have given rise to the Gotra, now known as Kasyapa. The existence of a wooden figure of the tortoise and pig seemed to bear out the theory suggested by him. Other papers in this section were contributed by Mr. Gopinatha Rau, on viragals and mastigals—the memorial stones set up in honour of heroes who fell in battle and women who died for their husbands; Mr. L. K. Ananta Krisna Iyer read papers on prehistoric monuments in Cochin, and on the Vettuvans of North Malabar.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject proposed for the Adams Prize Essay for the period 1915–16 is "The Course of Evolution of the Configurations possible for a Rotating and Gravitating Fluid Mass, including the Discussion of the Stabilities of the Various Forms." The investigation of the forms that can be assumed by a mass of gravitating fluid endowed with motion of rotation was initiated by Newton with reference to the figure of the earth, developed by Maclaurin, Clairaut, and Laplace, and extended by Jacobi. It was consolidated in Lord Kelvin's hands, as an example of the doctrine of the dissipation of energy, into a single problem illustrating the course of evolution of stellar and planetary systems. The sequence of the forms that can be assumed by a rotating fluid mass, first announced partially by Lord Kelvin, has been extended and systematised by the work of Poincaré, and expanded in new directions by Sir G. H. Darwin and other investigators. Further elucidation of this succession of forms, especially in the direction in which a tendency appears for the mass to divide into separate parts, is desirable, in view of its possible bearing on the modes of evolution of double and variable stars and the interpretation of other remarkable celestial objects. The case in which the mass is in whole or in part in the gaseous state may also present opportunities for investigations possessing astronomical interest. Some contribution to the further theoretical development of this subject is asked for. The prize is open to the competition of all persons who have at any time been admitted to a degree in the University. The value of the prize is about 220*l*. The essays must be sent to the Vice-Chancellor on or before the last day of December, 1916.

OXFORD.—On March 9 Congregation approved the appointment of Dr. H. M. Vernon, fellow of Magdalen College, as University lecturer in chemical physiology for four years, in succession to Dr. Ramsden, fellow of Pembroke College, who has been elected to the post of Johnson professor of biochemistry at Liverpool University. Congregation has also approved the re-appointment of Dr. J. W. Jenkinson, Exeter College, as University lecturer in comparative and experimental embryology for five years.

The Hebdomadal Council has lately put out an important statement dealing with the financial position of the University as affected by the war. It is estimated that, after allowance has been made for a considerable saving in the conduct of examinations, the statutable and necessary expenditure for the current year will exceed the ordinary receipts by at least 15,000*l*. This deficit may be reduced by various expedients, such as savings in respect of grants, and the suspension of repayment of loans (should the necessary powers be granted by the Bill now before Parliament), to a sum of about 6000*l*. The remainder may ultimately have to be made good by borrowing; but before the necessity for this step arises, the situation will, it is hoped, be to some extent relieved by the voluntary contributions of many of the officers and other members of the University.

IT is stated in *Science* that Dr. William J. Mayo and Dr. Charles H. Mayo, of Rochester, Minn., the distinguished surgeons, have decided to establish a 200,000*l*. foundation for medical research and to place the foundation, under certain restrictions, in the hands of the University of Minnesota.

We have received from the University Press of Liverpool a copy of a report of the Senate of the University upon research and other original work by members of the University published or completed during the session 1913–14. The titles of papers and other publications are arranged under faculties and numbered consecutively, those published during the session being placed first. The abbreviations adopted in the titles of scientific periodicals are those used in the "International Catalogue of Scientific Literature."

At a meeting held in New York, on January 27, in connection with the inauguration of the Engineering Foundation, it was announced, says *Science*, that the initial gift had been made by Mr. Ambrose Swasey, past-president of the American Society of Mechanical Engineers, who has given 40,000*l.* for "the advancement of the engineering arts and sciences in all their branches to the greatest good of the engineering profession and for the benefit of mankind." The administration of the fund will be entrusted to the Engineering Foundation Board, elected by the trustees of the United Engineering Society. From the same issue of our contemporary we learn that the sum of 8000*l.* has been given by Mr. Andrew Carnegie to Allegheny College for a chemical laboratory to replace that recently destroyed by fire; and that Mr. Patten, who has already given 100,000*l.* to the medical school of Northwestern University, has now added 5400*l.* for scholarships.

The Department of Agriculture and Technical Instruction for Ireland has issued particulars of the summer courses of instruction for teachers to be held this year in Ireland. The courses, with the exception of that in rural science for national school teachers to be held in August, will begin on July 6 and close on July 30. Among the courses arranged may be mentioned that on chemical manufactures intended for teachers of chemistry in technical schools who hold a university degree in chemistry or equivalent qualification; and those on the testing and working of electrical machines, practical mathematics and mechanics, hygiene and sick nursing, experimental science, and rural science (including school gardening). Teachers who attend the courses from the beginning to the end are allowed a sum of 3*l.* 10*s.* towards their expenses while living at the centre; and those who travel more than twenty miles to the centre of instruction are allowed, in addition, third-class railway fare for one return journey from the railway station nearest their school.

The metallurgy laboratory for the mechanical testing of metals and alloys, presented to the Sir John Cass Technical Institute by the Worshipful Company of Goldsmiths, was formally opened by Sir Boverton Redwood, Senior Warden of the Goldsmiths' Company, on March 3, in the unavoidable absence owing to illness of Sir Robert Mowbray, Prime Warden of the company. The work of this new laboratory, which will form an important extension of the metallurgy department of the institute, will be carried on from the metallurgical rather than from the engineering point of view, and will be closely related to the instruction already provided in connection with the metallographic and pyrometric examination of metals and alloys, including iron and steel and the materials used in the motor-car industry and in the construction of aeroplanes, high-speed machinery, and the like. Previous to the opening of the laboratory, Sir Boverton Redwood distributed the prizes gained by students of the institute during the past session, and delivered an address, the chair being taken by Sir Thomas Elliott, who has succeeded the late Sir Owen Roberts as chairman of the governing body. In speaking of the work of the institute, Sir Boverton Redwood said that such work as is being done was never more needed than at the present time. Among other things which the war has done for us, it has shown us that there must be a much more intimate relation between science and industry in this country; and it is to be hoped that the students will avail themselves to the fullest possible extent of the facilities which the institute affords them of becoming better qualified to discharge the duties with which they will be entrusted. If one result of the war is to bring about a better recognition of what is needed in this direction we shall have some compensation for the sacrifices which we are making. In referring to the courses on fuel and power, arranged at the institute, Sir Boverton pointed out the all-important part that is now being played by liquid fuel both in the Navy and on the field of battle on land, especially in connection with the "all-oil boilers" now in use on the battleships of the *Queen Elizabeth* class, all of which are driven solely by oil fuel.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, February 19.—Annual General Meeting.—Dr. A. Smith Woodward, president, in the chair.—Dr. A. **Smith Woodward**: Presidential Address. The progress of geology depends on so many lines of research, that each specialist does well at times to pause and consider the relation of his own small part to the whole. The president therefore reviewed some results of his study of fossil fishes in their bearing on stratigraphy. However necessary detailed lists of species of fossils might be for comparative work with sediments in restricted areas, he hoped to show that in dealing with broader questions names were really of small importance. Certain general principles had been arrived at, which would serve for all practical purposes. Each successive great group of fishes began with free-swimming fusiform animals, of which some passed quickly into slow-moving or grovelling types, while others changed more gradually into elongated or eel-shaped types. There was also a constant tendency for the primitive symmetry of the parts of the skeleton in successive members of a group to become marred by various more or less irregular fusions, subdivisions, and suppressions. Some of the successive species of each group increased in size, until the maximum was reached just before the time for extinction. These and many other more special inevitable changes had now been traced in most groups, and the various geological dates at which they occurred had been determined by observations on fossil fishes from many parts of the world. Even fragments of fish-skeletons, too imperfect to be named, were often therefore of value for stratigraphical purposes.

Royal Anthropological Institute, February 23.—C. **Dawson**: Flint implement cultures of the Sussex Ouse Valley, with special reference to the Piltdown gravel-spreads and deposits. Among the exhibits were originals and casts of the rude iron-stained Palæolithic implements discovered at Piltdown. They are really large flakes worked on one face, rather after the Chellean culture. The other face is unworked, like those from the Mousterian cultures. The large elephant-bone implement trimmed to a point like a stake at one end, and roughly rounded by cuts at the other end, was exhibited. By comparison it is found that this implement is made from one of the thigh-bones of a large species of elephant not yet discovered

later than Late Pliocene or Early Pleistocene ages. Mr. Dawson specially dealt with the "columnar" or "prismatic" flints of which the gravel-spreads of the neighbourhood is mainly composed. Among these flints have been discovered many of the Eolithic type forms and some *rostro-carinate* varieties.

Zoological Society, February 23.—Prof. E. W. MacBride, vice-president, in the chair.—Miss Kathleen **Haddon**: The methods of feeding and the mouth-parts of the larva of the glow-worm. External digestion is a phenomenon of fairly wide occurrence among various groups of insects, and the mouth-parts are in some cases specially adapted to this purpose. The larva of the glow-worm (*Lampyris noctiluca*) feeds on snails, of which it leaves no residue but an empty shell; it is unlikely that there is any preliminary anæsthetising as asserted by Fabre. The mandibles of the larva bite up the food and each mandible is pierced by a fine tube, through which a dark-coloured fluid is exuded. The bases of all the mouth-parts are covered with fine outwardly directed hairs, which are bathed in the juices of the snail whilst the larva is feeding; the juice is sucked into the œsophagus, which is extremely narrow, by the action of a pharyngeal pump similar to that found in other sucking insects.—Dr. J. F. **Gemmill**: Ciliation of asterids and the question of ciliary nutrition in certain species. The arrangement of the ciliary currents on the various surfaces of four widely different species of starfishes is described in detail. This arrangement is constant for all individuals in each of the species, and, except as regards external surfaces, is practically the same in all the species. Everywhere the arrangement is shown to be explicable by physiological needs. Ciliation in the perihæmal spaces is demonstrated.—R. E. **Turner**: New fossorial wasps. The wasps were mostly collected while on a recent expedition to Australia, but include a few received from the Queensland and West Australian Museums.—Lt.-Col. J. M. **Fawcett**: A collection of Heterocera made by Mr. W. Feather in British East Africa. The bulk of the species was taken at light during damp evenings, and perhaps the most interesting capture is that of a specimen of the celebrated *Actias besanti*, Rebel, a large and most beautiful Saturnid moth distinguished by its extremely long tails. This is a well-known rarity of the "first water," and only four specimens were previously known to have been taken, two of which are in the British Museum and two in Germany. Besides the forms described as new species, there are a good many previously described forms not as yet represented in the National Collection, which of itself is evidence of their raritv. Mr. Feather is to be especially congratulated upon the very perfect condition of his specimens and the very accurate record he has kept of the dates of their capture and the localities. Many of the forms dealt with in this memoir were only previously known to science through specimens brought from tropical West Africa, and were previously unrecorded from British East Africa. But this region still remains to be properly worked out, and a great field of research is in store for anyone who can find time to take the matter in hand.

CAMBRIDGE.

Philosophical Society, February 22.—Prof. Newall, president, in the chair.—Dr. **Arber** and R. H. **Goode**: Some fossil plants from the Devonian rocks of North Devon. In addition to the first record of an obscure plant specimen from the Lynton beds, some six other types are described from the Baggy or Cucullæa beds of the Upper Devonian. One of these, Xenotheca, is an entirely new fructification, consisting of thecæ with eight teeth, terminating the branches of a dichotomously branched axis. These thecæ are regarded as being probably of the nature of cupules. *Sphenopteridium rigidum*, Ludw., is recorded for the first time from Britain. The other fossils can only be identified generically as Sphenopteris sp., Telangium sp., Knorria sp., and Cordaites? sp. These are the oldest (in a geological sense) fossil plants of terrestrial habit yet known from England.—H. Hamshaw **Thomas**: Some new and rare Jurassic plants from Yorkshire—the male flower of *Williamsonia gigas*, L. and H. The female strobili of this species were described many years ago, but the male sporophylls have remained a matter for speculation. When examining the specimens in the Yates Collection in the Museum of Natural History at Paris, the author found an example showing an undoubted male flower of the same general type as *Williamsonia spectabilis*, Nath. Though not attached, there were strong reasons for regarding it as belonging to the species *W. gigas*. The flower was briefly described, and compared with other species in the genus.—Dr. C. E. **Moss**: Nomenclature of *Pteris aquilina*.

DUBLIN.

Royal Irish Academy, February 22.—Count Plunkett in the chair.—J. A. **McClelland** and J. J. **Dowling**: Some electrical properties of powders in thin layers. A very thin layer of a conducting powder, such as graphite, is formed on the surface of an insulator, usually paraffin. Tinfoil strips a few centimetres apart are fastened on the layer so as to make good electrical connection with it, and the conductivity of the layer measured. The strips being earthed, a high potential is applied to a plate parallel to the layer, a few millimetres of paraffin intervening between the plate and the layer. The conductivity of the layer is then found to be very much increased. The points of resemblance and of difference between this effect and the coherer effect are discussed in the paper, and the laws obeyed by the conductivity are studied in detail.

PARIS.

Academy of Sciences, March 1.—M. Ed. Perrier in the chair.—The President announced the deaths of George William Hill and G. F. J. Auwers, correspondants in the section of astronomy.—E. L. **Bouvier**: The adaptative forms of *Scyllarus arctus* and the post-larval development of Scyllarus.—Haton de la **Goupillière**: The sums of like powers of integral numbers.—J. **Guillaume**: Observations of the Mellish comet made at the Observatory at Lyons. Six positions given for February 20, 23, 25, and 26. The comet appeared as a circular nebulosity, diameter about half a minute of arc, with faintly marked excentric nucleus. Was about the 11th magnitude.—M. **Coggia**: Observations of the Mellish comet made at the Marseilles Observatory. Positions given for February 20, 23, and 25.—W. **Sierpinski**: A curve of which any point is a point of ramification.—André **Brochet**: The catalytic reduction of indigo. In slightly alkaline solution indigo is rapidly reduced by hydrogen in presence of suspended metallic nickel. The indigo white obtained has the advantage of being free from saline impurities.—J. **Caralp**: A Permian melaphyre in the Ariège Pyrenees.—Marin **Molliard**: Free nitrogen and the higher plants. Experiments are described proving that the radish, grown aseptically, is incapable of assimilating atmospheric nitrogen.—Georges A. Le **Roy**: The use of low temperatures in toxicological analysis. The fine subdivision of tissues is facilitated by a preliminary solidification by freezing.

BOOKS RECEIVED.

The Carnegie United Kingdom Trust. First Annual Report. Pp. 34. (Edinburgh: T. and A. Constable.)

Memoirs of the Geological Survey of India. Palæontologia Indica. Vol. v. Memoir No. 2. The Anthracolithic Faunæ of Kashmir, Kanaur, and Spiti. By Dr. C. Diener. Pp. 135+plates xi. (Calcutta: Geological Survey; London: Kegan Paul and Co., Ltd.)

Twenty-seventh Annual Report of the Purdue University Agricultural Experiment Station, Lafayette, Indiana. Pp. 88. (Lafayette: Haywood Publishing Co.)

Clark University, Worcester, Mass. Register and Twenty-seventh Official Announcement. Pp. 112. (Worcester, Mass.: Clark University.)

Memoirs of the Geological Survey, Scotland. Explanation of Sheet 74. The Geology of Mid-Strathspey and Strathdearn. By L. W. Hinxman and E. M. Anderson. Pp. v+97. (London: H.M.S.O.; E. Stanford, Ltd.) 2s. 6d.

Memoirs of the Geological Survey, England and Wales. Explanation of Sheet 269. The Geology of the Country around Windsor and Chertsey. By A. Dewey and C. E. N. Bromehead. Pp. vi+123. (London: H.M.S.O.; E. Stanford, Ltd. 2s. 6d.

DIARY OF SOCIETIES.

THURSDAY, MARCH 11.

ROYAL SOCIETY, at 4.30.—Contributions to the Study of the Bionomics and Reproductive Processes of the Foraminifera: E. Heron-Allen.—The Occurrence of an Intracranial Ganglion upon the Oculomotor Nerve in Scyllium Canicula, with a suggestion as to its Bearing upon the question of the Segmental Value of certain of the Cranial Nerves: G. E. Nicholls.—Experiments on the Restoration of Paralysed Muscles by Means of Nerve Anastomosis. III.—Anastomosis of the Brachial Plexus, with a consideration of the Distribution of its Roots: Prof. R. Kennedy.—On the Mechanism of the Cardiac Valves. A Preliminary Communication: A. F. S. Kent.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Cooking, mainly from the Consumer's Point of View: W. R. Cooper.

CHILD STUDY SOCIETY, at 6.—*Discussion:* The Care and Development of the Child—during School Age.—Treatment Centres and their Possibilities: Miss Margaret McMillan.—Care Committees: Mrs. Evelyn.

FRIDAY, MARCH 12.

ROYAL INSTITUTION, at 9.—Back to Lister: Sir R. J. Godlee.

PHYSICAL SOCIETY, at 8.—(1) The Estimation of High Temperatures by the Method of Colour Identity: (2) The Unit of Candle-power in White Light: C. C. Paterson and B. P. Dudding.—The Relative Losses in Dielectrics in Equivalent Electric Fields, Steady and Alternating (R.M.S.): G. L. Addenbrooke.

MALACOLOGICAL SOCIETY, at 8.—*Helicella crayfordensis*, n.sp. from the Pleistocene deposits of S.E. England: A. S. Kennard and B. B. Woodward.—Further Notes on Radulæ: the Rev. E. W. Bowell.—The Editions of Swainson's "Exotic Conchology": A. Reynell.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Double Stars Measured at the Cape: J. Voûte.—Comet Westland: E. H. Beattie.—A General Solution of Hill's Equation: E. Lindsay Ince.—Note on the Comparison of Two Plates of the Same Region in the Vatican Zones of the Astrographic Catalogue: Ethel F. Bellamy.—*Probable Papers:* The Dynamics of a Globular Stellar System. II.: A. S. Eddington.—The Secular Acceleration of the Moon's Mean Motion, as Determined from the Occultations in the Almagest: J. K. Fotheringham and Gertrude Longbottom.—Micrometrical Measures of Double Stars made in 1914: Rev. T. E. R. Phillips.

SATURDAY, MARCH 13.

ROYAL INSTITUTION, at 3.—Recent Researches on Atoms and Ions: Sir J. J. Thomson.

MONDAY, MARCH 15.

ARISTOTELIAN SOCIETY, at 8.—The Philosophy of Values: Dr. Tudor Jones.

VICTORIA INSTITUTE, at 4.30.—The Determination of Easter Day: Dr. A. M. W. Downing.

ROYAL SOCIETY OF ARTS, at 8.—House Building: M. H. Baillie Scott.

TUESDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—The Belief in Immortality among the Polynesians: Sir J. G. Frazer.

ROYAL STATISTICAL SOCIETY, at 5.15.—The Cost of the War: E. Crammond.

ILLUMINATING ENGINEERING SOCIETY at 8.—*Discussion:* The Marking and Rating of Lamps and the best methods of specifying their Illuminating Value.

MINERALOGICAL SOCIETY, at 5.15.—The Dispersion of Adularia from St. Gothard, Felspar from Madagascar, and Moonstone from Ceylon: Dr. S. Kôzu.—The Meteoric Stone of Launton, Oxfordshire: Dr. G. T. Prior.

WEDNESDAY, MARCH 17.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.45.—Students' Section Some Experiments on the Induction Generator: W. H. Date.

ROYAL SOCIETY OF ARTS, at 8.—The Industrial Uses of Coal Gas: H. M. Thornton.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Meteorology of the Sun: Dr. W. Geoffrey Duffield.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A New Mitotic Structure Disclosed as the Result of New Technique: E. J. Sheppard.—Notes on the Structure of Tests of Fresh-water Rhizopoda: G. H. Wailes.

THURSDAY, MARCH 18.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: X-rays and Crystals: Prof. W. H. Bragg.

ROYAL INSTITUTION, at 3.—The Form and Structure of the London Basin: Dr. A. Strahan.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Army: Lieut.-Colonel A. C. Yate.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual Meeting.

FRIDAY, MARCH 19.

ROYAL INSTITUTION, at 9.—The Modern Piano Player—Scientific Aspects: Prof. G. H. Bryan.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Chemical and Mechanical Relations of Iron, Cobalt, and Carbon: Prof. J. O. Arnold and Prof. A. A. Read.

SATURDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Recent Researches on Atoms and Ions: Sir J. J. Thomson.

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